SCM

MARCHANT

TENKEYMATIC

SERVICE INSTRUCTION BOOK

Order From
Office Machine Americanna
1740 Birch Ave
Lewiston, Idaho 83501

Pages 1 thru 1

TENKEYMATIC

ARRIVAL INSPECTION

Introduction

This material contains the instructions for the ARRIVAL INSPECTION for the Tenkeymatic Calculator. There are 48 separate items, arranged as follows:

A.	UNPACKING	Items 1 - 6
B.	PREPARATION FOR FUNCTIONAL TEST . .	" 7 - 18
C.	FUNCTIONAL INSPECTION	
	MECHANICAL TEST	" 19 - 29
	CALCULATING TEST	" 30 - 40
D.	FINAL EXAMINATION	" 41 - 48

Please note that Items 19 to 40 may be applied to any examination of the machine. The Final Inspection, Items 41 to 48, should be performed after every extensive Service Job.

In the case of test items which call for a particular condition of the machine, it is implied that, if the machine does not satisfy the condition, proper steps are to be undertaken to eliminate the shortcoming.

In order to facilitate their use, the instructions are provided in two forms. A long form, which contains detailed directions for the inexperienced TKM-man, and a short form for the experienced TKM-man. Both forms cover the same material.

IMPORTANT NOTE:

DO NOT OPERATE THE MACHINE UNDER POWER, EXCEPT AS DIRECTED IN ITEM 18. SEE ITEMS 14 AND 17.

A. U N P A C K I N G

1. Examine the shipping box.

The Tenkeymatic is shipped a great distance, loaded and unloaded several times. Shipping damage may be evident from the appearance of the box. This is an important item of the arrival inspection.

2. Remove the machine.

Open the box and remove the machine with its attached plywood base. Also, remove the paper bags containing the screws and internal feet.

3. Examine the mounting on the plywood base.

Set the machine on its back so that the plywood base stands upright and examine the screws which hold the machine on the base. This examination is important because a machine may have been heavily jarred even though the box does not show any appreciable damage. Look for loose, twisted or broken screws.

4. Remove the plywood base.

I F T H E M A C H I N E I S T O B E R E-S H I P P E D, save all the packing material, including the red-headed screws (Item 5) and the Shipping Angles (Item 9). In this case, pack the machine in the manner in which it was originally packed. Observe particularly the securing of the Calculating Carriage (Item 14).

5. Install the Permanent Holding Screws.

Look at the underside of the machine and observe that there are four screws whose rounded heads are painted red. They pass through the Bottom Cover into the Internal Feet and are long enough to bottom against the studs which hold the Internal Feet on the case frame. These screws have the purpose of disabling the floating characteristics of the Internal Feet while in transit. In operation, the machine must float, therefore, we must install shorter screws. The shorter screws are contained in one of the paperbags referred to under 1., above. Install them one by one. DO NOT TAKE OUT MORE THAN ONE SCREW AT A TIME. Moreover, observe the following

IMPORTANT NOTE:

> Of the four permanent holding screws, which are distinguished by flat heads, one is painted red. Insert this screw into the hole under the motor. This is the lower left hand hole, when the machine stands on its back.

If the longer shipping screws are not replaced by the permament screws, the machine will make excessive noise and may become damaged.

6. Install the Rubber Feet.

One of the paper bags mentioned under 1., above, contains two Rubber Feet. They are inserted into the front holes which held the screws for the plywood base. The rear holes for the plywood base are closed by the two other screws which are enclosed with the Rubber Feet. The machine, when in operation, will rest on the two Rubber Feet in front and on the two Rollers in the back.

B. PREPARATION FOR FUNCTIONAL TEST

7. Remove the Tabulator Knob.

Remove the Tabulator Knob in order to permit the removal of the Top Cover.

8. Remove the Top Cover.

The Top Cover is held by studs in front and by leaf springs in the back. Insert a small screw driver through the cut-outs in the back, pushing the leaf springs back, and remove the Top Cover by lifting it in the back and pulling forward at the same time.

9. Remove the Shipping Angles.

The machine is held during shipment by two angles which connect the heavy cast frame with the Bottom Cover. Remove these angles and save them if the machine is to be reshipped, otherwise discard. (See Item 4).

10. Check for parts that may have come off.

Examine the Bottom Cover for clips, nuts, springs, or other parts which may have come off during transit or may have been left in the machine during assembly and were shaken out in transit.

11. Check the Link 10160.

If the pin-fork connection of the Link 10160 (Fig. 48, Serv. Inst.) has come off, reinstall it on the Cycle Bail 11240, (#100, Serv. Inst.).

12. Check the Rocking Spring 10554.

This spring is located between parts which can move during shipment. It may have come off. (Fig. 56, Serv. Inst.).

13. Check the Detent Lever 10760.

This lever, (#85, Serv. Inst. and Adjustment 2), may have slipped off the Side Plate 10730.

14. Reset the Clutches.

When the machine is packed, the Main System is turned one half turn in order to lock the Calculating Carriage (#161, Serv. Inst.). This causes a disengagement of the Entry Clutch 12056 (Fig. 27, Serv. Inst.). In the course of shipment, the Clear Clutch 12060 may also become disengaged because it is immediately linked with heavy parts which are relatively free. Before the machine can be operated under power, the clutches must be returned to their home positions. For this purpose, U S E T H E H A N D C R A N K O N L Y. Insert it on the claw which is formed in the hub of the large gear on the right side of the machine. This is the gear which drives the Belt Pulley. C R A N K T H E M A C H I N E S L O W L Y I N A C L O C K W I S E D I R E C T I O N. The movement will stop when the clutches engage. If it stops before the clutches are in their home position, find the cause of the jamming and eliminate it. D O N O T F O R C E T H E M A C H I N E. D O N O T O P E R A T E U N D E R P O W E R.

After you have restored the clutches to their home position, turn the machine through at least two more cycles, initiating them by depression of the II/III Key.

15. Check the Main System.

After Item 14 has been satisfactorily completed, insert the handcrank on the Main System Shaft and turn the Main System through several cycles. Initiate these cycles by depressions of the Add-Key.

16. Check that all keys are up.

This is particularly important since a key may have been accidentally depressed during the preceding tests. A L L K E Y S M U S T B E U P F O R T H E F O L L O W I N G T E S T.

17. Check the power supply.

Compare the voltage rating of the available power supply with that given on the name plate of the machine. T H E M A C H I N E M U S T B E O P E R A T E D O N L Y W I T H T H E D E S I G N A T E D P O W E R.

18. Plug the machine in.

If the check under 17., above, has been satisfactory, connect the machine to the power supply and observe the following

IMPORTANT NOTE:

The machine must not run when it is connected. If it does, find and eliminate the cause before you continue.

C. FUNCTIONAL INSPECTION

MECHANICAL TEST:

19. Check the freeness of the keys.

Before you continue, make sure that all keys are moving freely in their cut-outs in the Keyboard Cover. Rap each key gently with a finger. It must bounce back. The NEG-Key and DIV-Key should remain firm under such gentle rapping.

20. Check the shifting of the Calculating Carriage - Reversing.

Observe the position of the Calculating Carriage. If it stands at either extreme, shift it a few steps toward the middle. Then depress in rapid sequence first the Right-Shift Key, then the Left-Shift Key, then the Right-Shift Key. Continue the depression in rapid sequence until you are sure that the Carriage shifts and reverses properly.

21. Check the shifting of the Calculating Carriage - Single Step.

Depress either Shift Key repeatedly until the Carriage is shifted to the respective extreme. Then shift the Carriage in single steps to the other extreme. Repeat this several times, increasing the rapidity of the sequential depressions. Even during rapid shifting, the Carriage must shift one position only for each depression of the Shift Key. At the end of this test, return the Carriage to the normal position, that is to the extreme left.

22. Check the overrun of the Calculating Carriage.

With the Carriage in the home position, all registers clear, depress the Equals-Key. The Carriage must rock slightly to the left and back. Repeat this several times.

23. Check the DIV-Key.

Depress, latch and unlatch the DIV-Key several times. With the DIV-Key depressed, try to depress the Subtract-Key and the Equals-Key. They must both be blocked.

24. Check the NEG-Key.

Depress, latch and unlatch the NEG-Key. Depress again and leave latched. Depress the DIV-Key. This must release the NEG-Key.

25. Attach the Tabulator Knob.

Attach the Tabulator Knob and turn it to zero, that is as far clockwise as possible (looking from the right side of the machine).

26. Check the operation of the Tabulator.

Work the problem "76543210 divided by 1". Since the Tabulator has been set to zero, the fixed order indicator in Reg. II should point to the "0" in the quotient. The Calculating Carriage should be in the home position.

Now depress the Right-Shift Key to bring the Calculating Carriage into the division start position, set the Tabulator to the position "1", and depress the Left-Shift Key. The Calculating Carriage will shift to the left and should stop so that the fixed order indicator points to the "1" in the quotient. Continue this for all positions of the Tabulator. At the end, return the Tabulator to zero.

27. Check the operation of the Division Stop Mechanism.

Work the problem "76543210 divided by 1". During division rock the Division Stop Lever. Division should stop. Depress Left Shift Key, division should restart. Stop in various positions and restart.

28. Check the Entry and the Backtransfer Key.

Key in the values "1" through "9" and depress the I/X Key. All values must appear in Register I. Try to depress the Backtransfer Key. It must be blocked.

Now depress the I/X Key and again the Backtransfer Key. It must now be possible to depress the Backtransfer Key.

29. Check the Backtransfer.

With the Calculating Carriage in the home position (left side), key in the value "999999999" (nine 9's). Depress the Add-Key. Register I must show all "9's". Now depress the I/X Key, then the Backtransfer Key, then the Add-Key, then the I/X Key. Repeat at least ten times. Check whether you are still working with the original entry.

C A L C U L A T I N G T E S T :

30. Check Addition and Subtraction.

Enter the values "1" through "9" and depress the I/X Key. Then depress the Add-Key and the Subtract Key in rapid sequence. The entry must appear in Register I and remain there. It must appear and disappear in Register III. Check whether the entry in Register III is still the same as that in Register I.

31. Check the Tens-Carry in Register III.

With the Calculating Carriage in the home position, enter the value "1" and depress the Subtract-Key. The entire Register III must change from "0" to "9". Then depress the Add-Key. The Register must change back to "0". Repeat several times.

32. Check the Tens-Carry in Register II.

Clear Register II. Depress the Subtract Key. The entire Register must change from "0" to "9". Then depress the Add-Key. The entire Register must change back to "0". Repeat several times.

33. Check Division.

Bring the Calculating Carriage into the division start position but do not depress the DIV-Key. Enter the value "80000001" and depress the Subtract Key. The value "19999999" must appear in Register III. Now depress the DIV-Key. Enter the value "1" and depress the I/X-Key. Then depress the Left-Shift Key. Division must start and bring the value "19999999" into Register II. Register III must show "0". Repeat at least three times.

34. Check for proper clearance of Reg. II and Reg. III.

With the Calculating Carriage in the home position, enter the value "1" and depress the Subtract Key. Both Registers must show "9". Now sharply hit the II-Key. This must clear Register II. Then sharply hit the III-Key This must clear Register III.

Repeat the same for the II/III-Key.

Repeat the entire test several times.

35. Check Multiplication - Non-Shortcut.

Multiply, using "12345123" as multiplier and "1" as multiplicand. The answer must be "12345123".

36. Check Multiplication - Shortcut.

Multiply, using "99999999" as multiplier and "1" as multiplicand. The answer answer must be "99999999".

37. Check Multiplication - Mixed.

Multiply, using "65656565" as multiplier and "1" as multiplicand. The answer must be "65656565".

38. Check Multiplication - Negative.

Depress the NEG-Key. Multiply, using "65656565" as multiplier and "1" as multiplicand. The answer must be "99999999343435".

39. Check the Sensing Finger Shifting.

Multiply, using 106000 as multiplier and "1" as multiplicand. The answer must be "106000".

40. Check Constant Multiplier.

Multiply, using "55555555" as multiplier and "1" as multiplicand. Do not clear any register. Enter the value "999999999" and depress the Add-Key. Repeat the Add-Key operation several times. Clear Registers II and III, enter the value "1" and depress the Equals-Key. The value "55555555" must appear in Registers II and III.

D. FINAL INSPECTION

41. Check the mounting of the machine.

The machine is mounted in the Bottom Cover on four internal feet which provide a floating support. No part of the machine must contact any part of the covering.

Inspect visually whether the machine contacts the Bottom Cover at any point. Then enter "66666666" as multiplier and "999999999" as multiplicand. While the machine calculates, apply pressure to the motor and other parts of the frame. By hearing and feeling, you will be able to tell whether the machine makes contact under pressure.

42. Check the Decimal Slides.

Check the operation of the Decimal Slides in the Top Cover, making sure that they move easily and are not bent.

43. Check the inside of the Top Cover.

Check the inside of the Top Cover to find out whether the machine has touched the Top Cover during shipment.

44. Put the Top Cover on.

Put the Top Cover on by reversing the procedure described for its removal. The Leaf Springs will snap in under firm pressure.

45. Check for noise.

Multiply, using "66666666" as the multiplier and "999999999" as multiplicand. Listen for noise. It should not be excessive.

46. Check for clearance within the Top Cover.

Multiply as in Item 45. While the machine calculates, apply pressure to the Top Cover in various ways. If the machine makes contact, you will feel it and hear the added noise.

47. Outer Appearance.

Check the outer appearance of the machine and of the Dust Cover. Look for scratches, blisters, and other faults.

48. Check the carrying handle.

Make sure that the carrying handle functions properly.

TKM - ARRIVAL INSPECTION

SHORT CHECK FORM

For detailed explanation of check items, refer to long form of Arrival Inspection.

A. UNPACKING

1. Examine the Shipping Box.
2. Remove the machine.
3. Examine the mounting on the Plywood Base.
4. Remove the Plywood Base.
5. Install the permanent holding screws, one at a time.
6. Install the Rubber Feet.

B. PREPARATION FOR FUNCTIONAL TEST

7. Remove the Tabulator Knob.
8. Remove the Top Cover.
9. Remove the Shipping Angles.
10. Check for parts that may have come off.
    (Nuts, screws, clips, springs, etc.)
11. Link 10160.
12. Rocking Spring 10554.
13. Detent Lever 10760.
14. Reset Clutches.
    (Handcrank only, no power)
15. Check Main System.
16. Are all Keys up?
17. Check power supply.
    (Must correspond to rating on Name Plate)
18. Plug in the machine.

IMPORTANT NOTE:

DO NOT OPERATE THE MACHINE UNDER POWER, EXCEPT AS DIRECTED IN ITEM 18, BELOW. SEE ITEMS 14 AND 17.

C. FUNCTIONAL INSPECTION

MECHANICAL TEST

19. Are the keys springy?
20. Shift the Calculating Carriage - Reversing.
21. Shift the Calculating Carriage - Single Step.
22. Overrun of Calculating Carriage.
    (Must rock beyond home position)
23. DIV-Key.
    (If down, NEG-Key blocked)
24. NEG-Key.
    (Released by DIV-Key)
25. Attach the Tabulator Knob.
    (Turn to zero, all the way clockwise)
26. Operation of Tabulator.
    (76543210 ÷ 1; stop in all positions)
27. Entry and Back Transfer.
    (Enter 123456789, 1/X-Key, Backtr.-Key blocked; I/X, Backtr. free)
28. Operation of Division Stop.
    (Above problem, stop in various positions)
29. Backtransfer.
    (Enter 99999999, Add-Key, I/X-Key, Backtr.-Key, etc., no change)

CALCULATING TEST

All calculation problems performed by entering the factors in the sequence given.

30. Addition and Subtraction.
    (Enter 123456789, I/X-Key, Add-Key, Subtr.-Key, Add-Key, etc.)
31. Tens-Carry in Register III.
    (Enter "1", Subtr.-Key, Add-Key, Subtr.-Key, etc., "999-000-999")
32. Tens-Carry in Reg. II.
    (Subtr.-Key, Add-Key, Subtr.-Key, etc., "999-000-999")
33. Division.
    (Div. start position; enter 80000001; Subtr.-Key, 19999999 in Reg. III; DIV-Key; enter "1", I/X-Key, Left Shift Key; 19999999 in Reg. II)
34. Clearing Register IIand III.
    (Clear by hitting sharply II, III, II/III)
35. Multiplication - Non-shortcut.
    (12345123 x 1 = 12345123)
36. Multiplication - Shortcut.
    (99999999 x 1 = 99999999)
37. Multiplication - Mixed.
    (65656565 x 1 = 65656565)
38. Multiplication - Negative.
    (NEG-Key down; 65656565 x 1 = 9999999934343435)
39. Sensing Finger Shift.
    (106000 x 1 = 106000)
40. Constant Multiplier.
    (Multiply: 55555555 x 1; do not clear; enter 99999999 and depress the Add-Key; enter 99999999 and depress the Add-Key; repeat 10 times; clear Reg. II and III; enter "1"; Equals-Key; must register 55555555)

D. FINAL INSPECTION

41. Mounting in Bottom Cover
    (66666666 x 99999999; no contact, excessive noise)
42. Decimal Slides.
    (Free movement)
43. Inside of Top Cover.
    (Contact marks)
44. Put Top Cover on.
45. Check for noise.
    (66666666 x 99999999, listen)
46. Clearance in Top Cover.
    (66666666 x 99999999, press, push, feel, listen)
47. Outer appearance.
    (Flaws in paint, scratches, discoloration)
48. Carrying Handle.
    (Comes out easily, stays in securely)

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- I N D E X -

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SECTION 5. SHIFT OF THE CALCULATING CARRIAGE AND AUTOMATIC DIVISION

SECTION 6. COUNTING FINGERS

SECTION 7. INTERLOCKS

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TENKEYMATIC

SECTIONS

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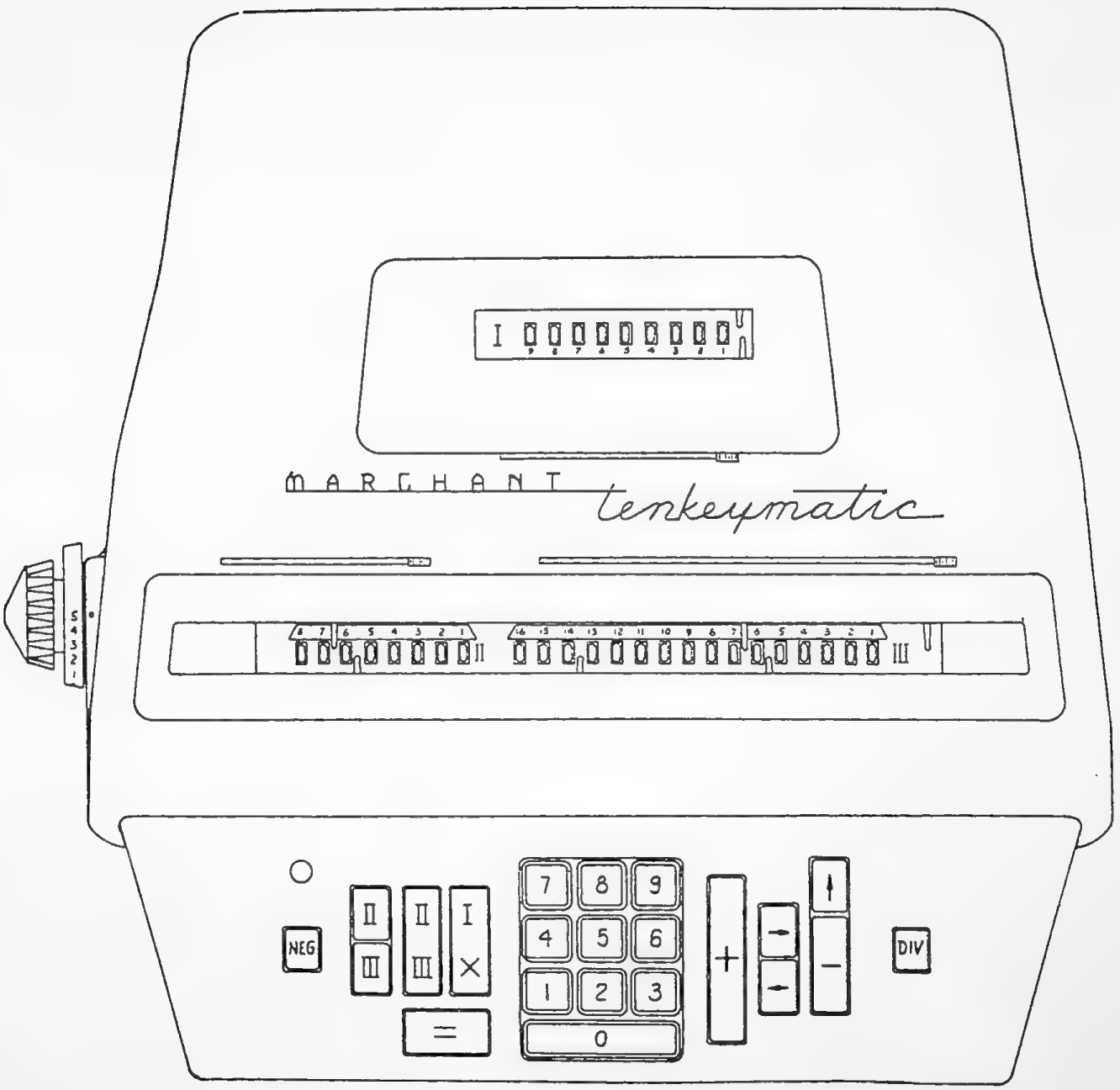


FIG. I

MARCHANT

TENKEYMATIC

INTRODUCTION

#1. The TENKEYMATIC is an automatic ten-key calculator for general office work. Its mechanism represents a new approach to accomplish the well known functions of mechanical calculating machines and bears, therefore, only superficial similarity with other MARCHANT models.

The most striking features of the TENKEYMATIC are SHORT-CUT MULTIPLICATION which reduces the time required for multiplication, and backtransfer which permits the continuous execution of certain problems. Another important feature is the quietness of operation, resulting from the sound-proof covers which enclose the entire mechanism.

#2. It will be observed that some parts are numbered with prefixes, for example, RZ7958, RG14200. The prefixes have no significance in the service instructions of the TENKEYMATIC. There is no duplication of part numbers on this model, however, in order to avoid confusion with other MARCHANT parts, any reference to a TENKEYMATIC part must be indicated as such.

#3. The indexing system used in this book is based on paragraphs. Most references are given by paragraph numbers. The following is a typical reference taken from paragraph #15.

> The entry of every digital value causes a
> one-step escapement of the Pin Carriage. (#32)

This means that the particular feature i.e. Pin Carriage escapement, is explained in more detail in paragraph #32.

GENERAL DESCRIPTION

The TENKEYMATIC performs addition, subtraction, multiplication (short cut), and division.

#4. Register I is fixed, the registers II and III move with the Calculating Carriage. Decimal point slides are provided on all three registers. They may be adjusted to cover various combinations, whereby the I-slide moves the III-slide independently of the II-slide, and the II-slide and III-slide move each other independently, within a certain range of the I-slide.

#5. Three clear keys are provided, marked II, III, II/III, to clear the registers correspondingly. The I/X Key clears the register I before it functions as a multiply key. The Add (+) and Subtract (-) Keys actuate addition and subtraction. Two horizontal arrow keys shift the Calculating Carriage in the indicated directions; the vertical arrow key actuates back transfer if the register I is clear. The DIV- Key pre-conditions the machine for division. The Product Key (=) starts the machine in multiplication after the second factor has been entered. The NEG-Key reverses the register III (counter) under certain circumstances. The Divide and Negative Key may be released by tipping them away from the machine.

The knob on the left side controls termination of division according to the number or orders set.

#6. The machine uses standard 110 volt current. A combination of key depression should not cause a jam. A carry handle is provided. It is located at the front of the machine and slides out if lifted slightly.

CALCULATING FUNCTIONS

The following operations may be performed:

#7. ADDITION: Shift the Calculating Carriage to the extreme left(left-arrow key); clear all registers (II/III and I/X Keys); enter a value (ten key board); depress Add Key(+). The value appears in registers I and III, register II counts the number of revolutions. Enter another value, depress Add Key. Register I shows the second value, register II the total number of revolutions, register III the sum.

#8. SUBTRACTION: Clear all registers. Enter a value and depress Add Key; enter a smaller value; depress the Subtract Key(-). The register I shows second value; register II shows the number of revolutions resulting from the second value. (If the negative key had been depressed before entry of the second value, the counter would not have been reversed). The register III shows the first value less the second. It is possible to calculate below zero, i.e. to subtract a larger from a smaller value.

#9. MULTIPLICATION: Clear all registers. Enter a value; depress the Multiply Key(I/X); the factor appears in register I. Register II and III remain zeros. Enter another factor; depress the Product Key(=). Register I shows the second factor, register II the first factor, register III the product.

#10. DIVISION: Clear all registers; depress DIV-Key; shift Calculating Carriage to the right. Enter dividend; depress Add Key. The value appears in registers I and III. Enter divisor; depress I/X Key; the divisor appears in register I, dividend unchanged in register III. Depress the Left-Shift Key. The machine begins to calculate and stops. The divisor is still in register I, register III shows a remainder, register II shows the quotient. The number of zeros to the right of the white marker in register III is equal to the number set on the knob on the left side of the machine.

#11. BACKTRANSFER: Clear register I. Depress the Backtransfer Key at any position of the Calculating Carriage. The amount in register III will be transfered to register I, and register III will be cleared.

#12. Figure 3 shows the features essential to the functions described in #7 to #11. The value keys 0 to 9 lift the Intermediate Levers 13829. The Intermediate Levers 13829 push up the Pins in the Pin Carriage. After depression of a function key, the Add Key for example, the Sensing Levers 11675 advance and are stopped by the raised Pins.

#13. The depression of a function key will also cause the Sensing Levers 11675 to be connected with the Entry Segments 11415 before the Pin Carriage is sensed. Then the value is transferred from the Pin Carriage to the Entry Segments 11415 which are engaged with the Intermediate Gears RZ7958. Register I having constant engagement with the Intermediate Gears RZ7958 will receive the entered value at once. The entered value is also transferred to the Main System and eventually to register III.

#14. The Step Disc 10775 (Fig. 2), together with the Sensing Fingers and the Multiplier Carriage, control multiplication, which is described in detail in #77 to #132. Upon depression of the Multiply Key the Step Disc 10775 is rocked forward so that its gear engages the lower gear sector of the Entry Segment 11696. When the entered value is entered into register I, it is also entered into the Step Discs 10775 and is represented by the changed position of the various notches. The Sensing Fingers sense the notches and actuate the mechanism which controls the short cut multiplication. The Multiplier Carriage moves the Sensing Fingers from order to order until all Step Discs 10775 are sensed.

The various mechanisms necessary to accomplish all of the above functions are described hereafter in detail.

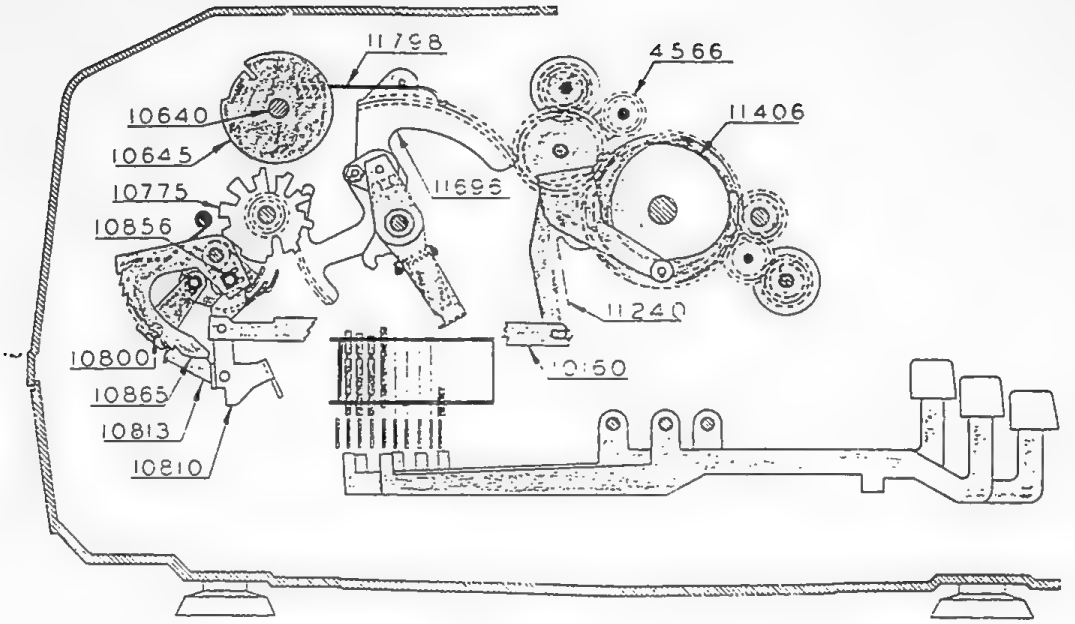
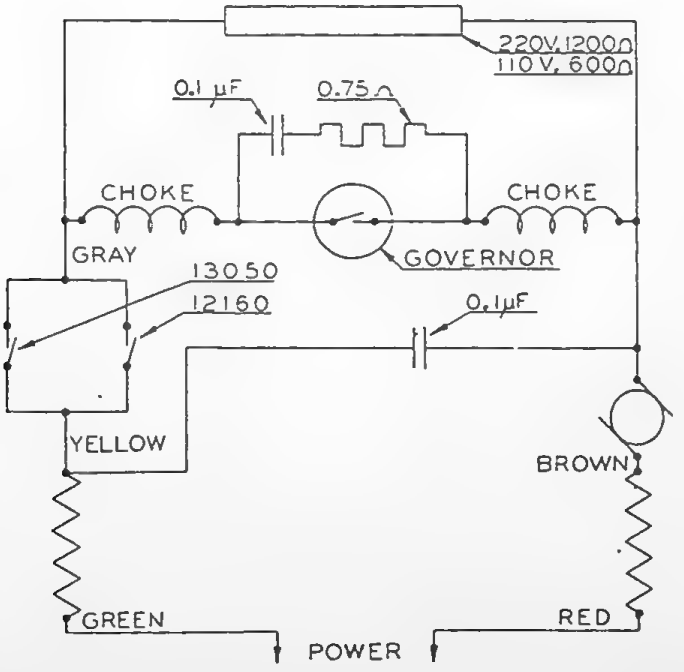


FIG. 2



SCHEMATIC WIRING DIAGRAM

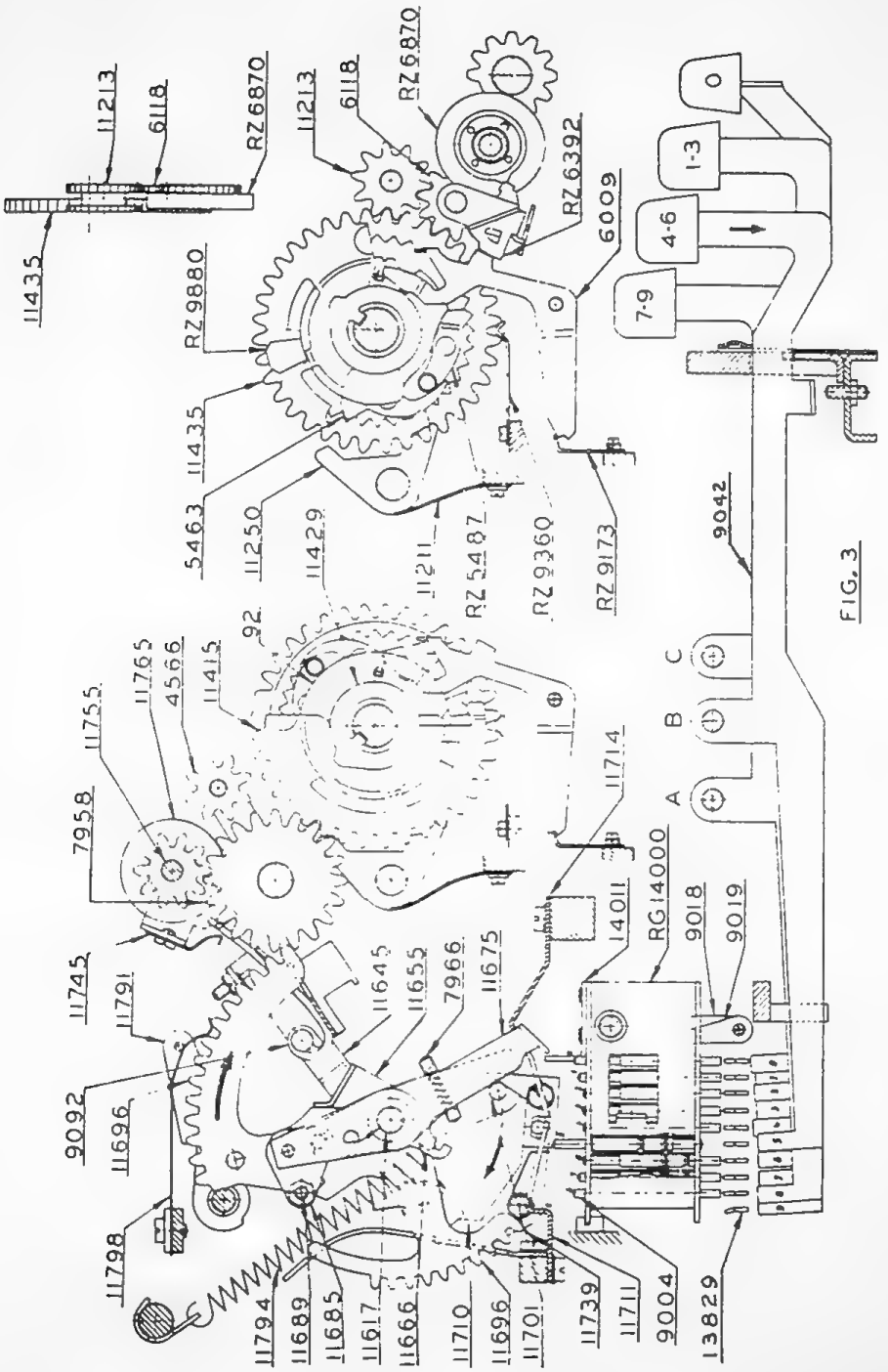

11213
6118
RZ6870
11435
11213
6118
RZ6870
RZ6392
6009
RZ9880
11435
5463
11250
11429
11211
RZ5487
RZ9360
RZ9173
9042
0
1-3
4-6
7-9
A
B
C
11714
14011
RG14000
9018
9019
11765
4566
11415
92
11755
7958
11745
11791
9092
11696
11798
11645
11655
7966
11675
11794
11689
11685
11617
11666
11710
11696
11701
11739
11711
9004
13829

FIG. 3

I. MODE OF OPERATION.

A. ENTRY MECHANISM.

#15. Fig. 3 The entry will be described as though the machine contained only one Value Key, one Key Lever 9042, etc. It must be understood that these remarks apply to all Value Keys "0" to "9" and to every value entry. Depression of the Value Key swings the Value Key Lever 9042 about shaft A, (or B, or C) and lifts the Intermediate Lever 13829. The Intermediate Lever 13829 pushes a Value Pin 9004 in the Pin Carriage. All Intermediate Levers 13829 (pivoted on a common shaft) are actuated by the Value Key Levers at different points, and have their ends always aligned with one ordinal row of Value Pins 9004, as well as with other parts yet to be described. (#32). The entry of every digital value causes a one-step escapement of the Pin Carriage.

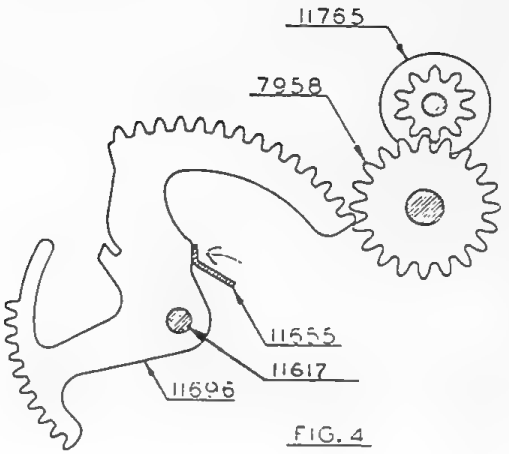


FIG. 4

#16. Figure 4. The entry of a value followed by a depression of either the Add Key ,or the Subtract Key, or the I/X Key, will cause a counter clockwise movement of the Clear Bail 11655 (#65) about Shaft 11617, if a previous entry is still in Register I. The Entry Segments 11696 are returned to their normal positions, and since the Entry Segments 11696 are in mesh with the Intermediate Gears 7958, the Check Dials 11765 are brought to zero, and Register I is cleared (#67). This clearing operation is part of every entry of a value, which explains the I/X-key whose marking implies a double function.

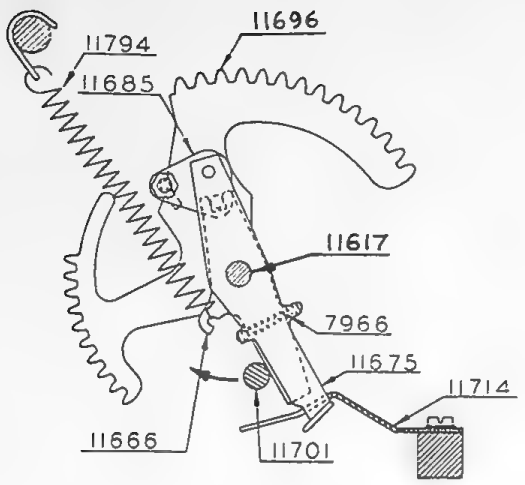


FIG. 5

#17. Figure 5. It is only after the clearance in the entry cycle, that the machine is ready to receive the entry which so far is only entered in the Pin Carriage.

The Swing Bar 11701 holds the Connecting Lever 11666 in a counter-clockwise direction which forces the Sensing Lever 11675 against the Fixed Stop 11714, by means of spring 7966 as shown in Fig. 5A. The Swing Bar 11701 moves clockwise about the shaft 11617 in the direction of the arrow in the early part of the operation (#54).

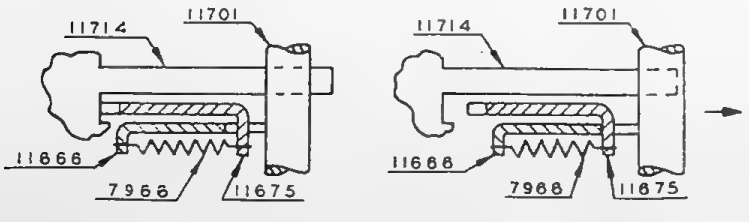


FIG. 5A

The Connecting Lever 11666 advances a short distance in the direction of the arrow before it picks up the Sensing Lever 11675. Till then, the Sensing Lever 11675 is held against the Fixed Stop 11714 by Spring 7966. During the short advance, the Connecting Lever 11666, by its fork, has swung the Latch 11685 into engagement with the notch in the Entry Segment 11696, as shown in Fig. 5B.

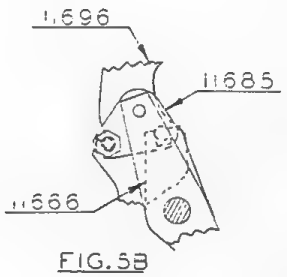


FIG. 5B

Pulled by Spring 11794, the Sensing Lever 11675 and the Entry Segment 11696 move now as one Sensing Unit, turning clockwise and following the Swing Bar 11701. The Non-Entry Bail 14011 on the Pin Carriage, prevents the advance of the Sensing Levers 11675 in all orders to the left of the entered value.(Fig. 6). The other Sensing Units advance until they stop on thei respective pins,for example the "5" Pin. The

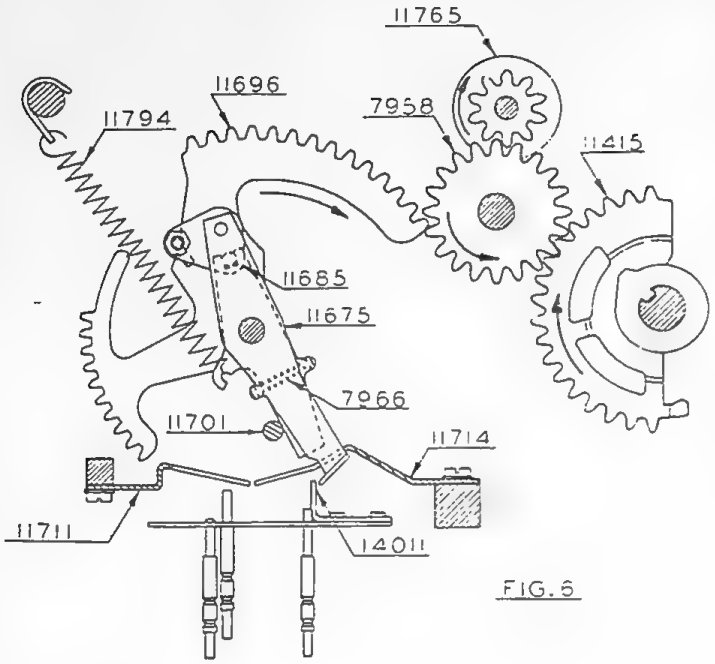


FIG. 6

stopping of Sensing Levers 11675 on the Pins does not stop the Swing Bar 11701, which advances to permit the Sensing Levers 11675 to sense any value up to "8" and to contact, if necessary, the "9" Stop 11711,as no "9" Pin is provided.

#18. Figure 7. The Entry Segment 11696 follows, turning the Intermediate Gear 7958 and the register I Dial 11675 as well as the System Segment 11415.

A Spring Comb 11798 is normally forced by the Bar 11791 into the teeth of the Entry Segment 11696 (#55) to lock it in the selected position. Early in the entry cycle after the clear operation, the Bar 11798 was lifted and the Spring Comb 11798 relaxed for the entry of the new value. While the Spring Comb 11798 remains disengaged, a second locking arrangement becomes effective. The Swing Bar 11701 continues to move and contact the tail of the Locking Lever 11645, turning it clockwise

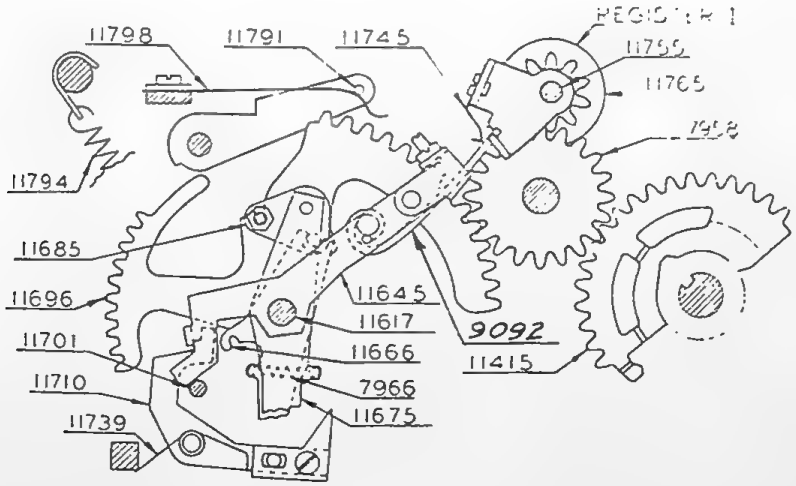


FIG. 7

about the Shaft 11617. This rocks the tail of the Locking Lever 11645 high enough for the Spring 11739 to force Latch 11710 under the ear of the Locking Lever 11645. On the other end of Locking Lever 11645 is a Spring 9092 which engages one side of Spring Comb 11745, rotating it counter clockwise about Shaft 11755 and forcing it into the teeth of the Intermediate Gear 7958. Thus, register I, the Intermediate Gear 7958, the Entry Segment 11696, and the System Segment 11415 are locked in the selected position. As the Swing Bar 11701 returns to the normal position, it contacts the triangular tail of the Latch 11710 and releases the Locking Lever 11645 shortly before the end of the entry cycle, but after the Spring Comb 11798 has been re-engaged by the clockwise movement of the Bar 11791. The Latch 11685 will be disengaged as the Swing Bar 11701 returns to the normal position and rocks the Connecting Lever 11666 in a counter clockwise direction. (17).

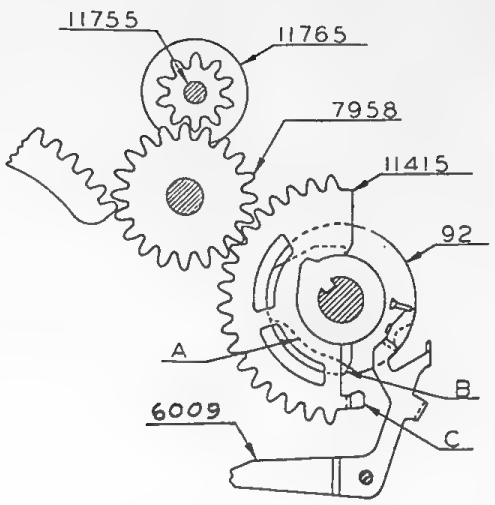


FIG. 8

B. DRIVE LATCH SYSTEM

#21. Figure 8. In the zero position of register I, which occurs only when the entry mechanism is in the normal position, the System Segment 11415 has the position shown above. In all cases, Shutter 92 is held in its position by the Sutter Opener 6009 whose other function is yet to be explained (24). The surface of Shutter 92 has a reduced portion "A". The System Segment 11415 has a Segment Disc attached to it, of the same radius as the Shutter 92. The Segment Disc rocks on the System Shaft 11400 next to the Shutter 92. The Segment Disc terminates in a cam edge "B" which is opposite a nose "C"

of the System Segment 11415. Figure 8 shows the zero position which is a near overlapping of the reduced portion "A" of the Shutter 92 by the Segment Disc of the System Segment 11415 and only a small notch is left.

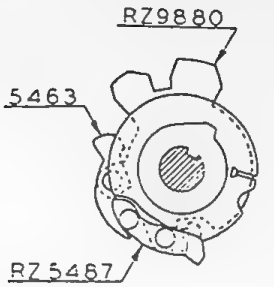


FIG. 10

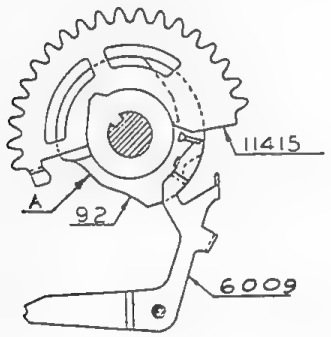


FIG 9

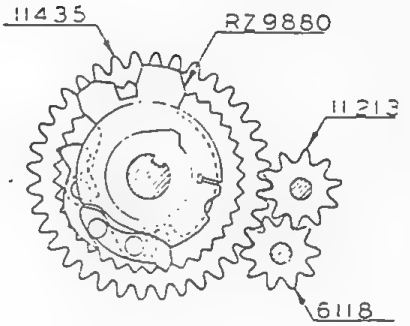


FIG.10A

After a value has been entered, for example "9", the System Segment 11415 has been moved clockwise (Figure 9) and a much larger part of the reduced portion "A" on the Sutter 92 is exposed. #22. Figure 10. After the entry described so far with respect to the System Segment 11415, (but still within the cycle initiated by depression of a function key, such as the Add Key), the Main System Shaft 11400 is put through one revolution counter clockwise by means yet to be described (#53). The Drive Disc RZ9880 is fastened to the Main System Shaft 11400 and rotates with it in a counter clockwise direction. Pivoted on the Drive Disc RZ9880 is a Drive Latch RZ5487, spring urged clockwise, and the Overthrow Latch 5463, spring urged counter clockwise. The Drive Latch RZ5487 has a roller which follows the edge of the Shutter 92 under spring pressure and, to the extent of the overlap shown in Fig. 9, #21, the edge of the Segment Disc. Depending upon the displacement of the System Segment 11415 with respect to the Shutter 92, that is,

depending upon the value entered, the roller of the Drive Latch RZ5487 passes into the range of the reduced portion "A" on Shutter 92. (Figure 8) It then rides on the edge of the Segment Disc until it comes to the cam edge "B" on the Segment Disc where it is spring urged toward the Main System Shaft 11400. The nose "C" on the System Segment 11415, in cooperation with the cam edge "B" on the Segment Disc, positively cams the roller, aiding the spring action. When the roller of the Drive Latch RZ5487 is cammed into the reduced portion "A" on the Shutter 92, the tail moves in the opposite direction and engages the internal gearing of the System Gear 11435. The Overthrow Latch 5463, spring urged against the roller of the Drive Latch RZ5487, likewise engages the System Gear 11435. Both latches drive the System Gear 11435 for a distance corresponding to the entered value until the Drive Latch RZ5487 is forced to leave the reduced portion of the Shutter 92.

In orders in which no value has been entered, the roller of the Drive Latch RZ5487 dips when passing by the notch (Figure 8) but does not go into engagement.

#23. Fig. 11. The movement of the System Gear 11435 is transmitted to the Dials RZ6870 of register III by Intermediate Gear 6118.

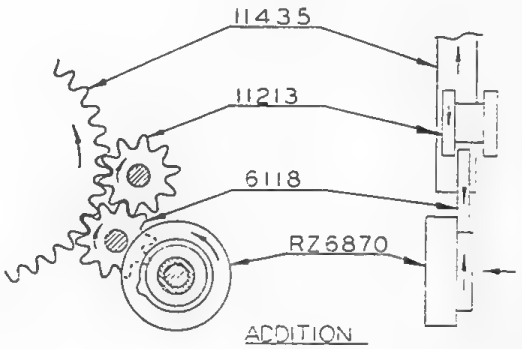
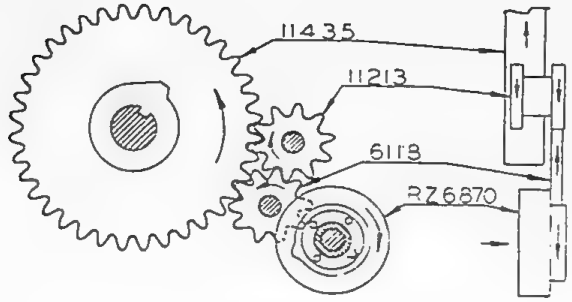


FIG. 11

In positive drive,(addition), Fig. 11., the Intermediate Gear 6118, which is in constant mesh with the driving gear of Dial RZ6870, meshes also with the right side of the wide System Gear 11435. The left gear of the double Reversing Gear 11213 is in constant mesh with the System Gear 11435 but in positive drive, the gear is non-functional and idles.

In negative drive, Fig. 12.,(sub-



SUBTRACTION

FIG. 12

traction), the Calculating Carriage is moved (by depression of the Subtract Key #135), far enough to the right to disengage the Intermediate Gear 6118 from the System Gear 11435 and engage it with the right gear of the Reversing Gear 11213. (Figure 12) The Dial RZ6870 is now driven in reverse, that is, negatively.

C. TENS CARRY IN REGISTER III

#24. Fig. 13 The tens-carry in register III must occur after the value has been entered, rather then at the same time, as in the present Marchant Calculator. The Shutter 92 has a second reduced portion "D" which is normally overlapped, by the edge "E" of the Shutter Opener 6009. When a Dial RZ6870 passes through the positve "0", a tooth on a carry disc assembled on the dial rocks the Tens-Carry Lever RZ6392 which then pushes the Shutter Opener 6009 to the left, exposing the reduced portion "D". When the Drive Latch RZ5487 is brought into this area, its roller is forced into the reduced portion "D" and the System Gear 11435 is engaged and driven as described in #22. This happens only long enough to enter the value of "1" into the next Dial RZ6870 to the left, or subtract it, as the case may be.

#25. The carry disc is free to rotate about one increment with respect to to the Dial RZ6870 which enables it to function in both directions.

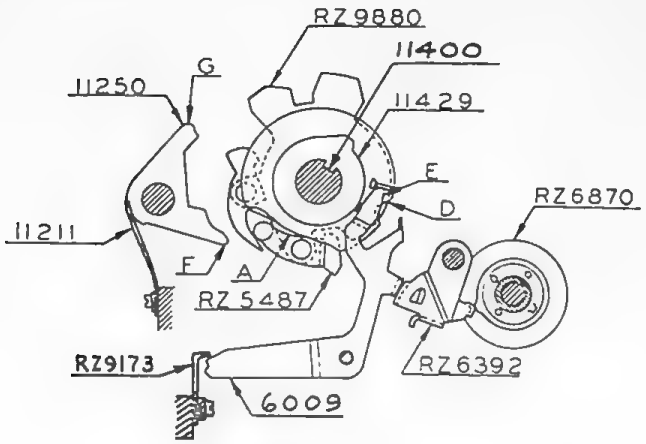


FIG. 13

#26. The Shutter Opener 6009 is held in its two positions by the Spring Comb RZ9173. All Shutter Openers 6009 are restored by the Tooth Disc 11429 near the end of the cycle of the Main System Shaft 11400. The Tens-Carry Levers RZ6392 return by gravity.

#27. The Locking Rocker 11250, under friction of Spring Comb 11211, has a tail "F" which is struck by the first lug of the Driving Disc RZ9880 when the Driving Latch RZ5487 leaves the reduced portion "A" of the Shutter 92. It may be also struck during tens-carry by the second lug when the follower leaves the notch "D". In both cases, tooth "G" engages and positions the System Gear 11435.

D. CLEARANCE AND BACK TRANSFER

#28. Fig. 14. For the purpose of clearance, part of the geared portion of the Dial RZ6870 of register III, as well as of register II, has been cut as shown in Fig. 14a. The cut-out is large enough to permit the Clearing Gear RZ12395 to pass through it. If the Dial RZ6870 is in zero position, the Clearing Gear RZ12395 cannot affect it. From all other positions, the Dial RZ6870 will be turned until the Clearing Gear RZ12395 can pass through the cut-out portion. The

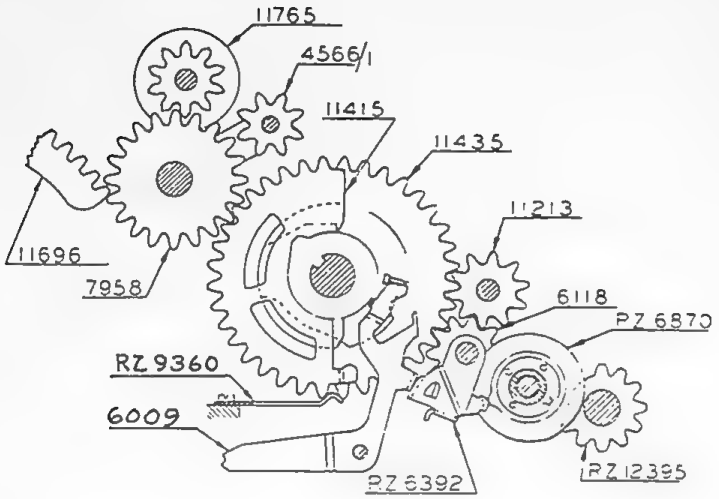


FIG. 14

FIG 14a

Clearing Gear RZ12395 is cyclically driven upon depression of a clear key from its normal position through a full turn. In order that it may not be turned by the Dial RZ6870, two teeth are omitted.

#29. In back transfer , a Back Transfer Gear 4566/1 is brought into engagement (#76) , with the System Gear 11435 and with the System Segment 11415. The register III is then cleared and the connected elements are driven in reverse, the train being RZ12395, RZ6870, 6118, 11435, 4566/1, 11415, 7958 and 11765, and 11696. The detent Spring RZ9360 is used to stabilize the System Gear 11435. The Shutter Opener 6009, through the Tens-Carry Lever RZ6392, prevents an overthrow of the Dials RZ6870.

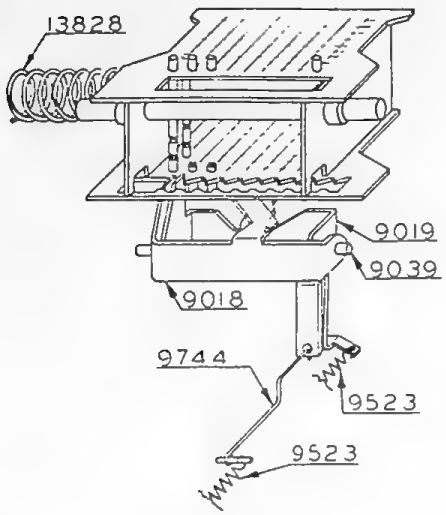


FIG. 15

2. CONTROL OF THE PIN CARRIAGE

A. THE SHIFT LOCK

#30. Fig. 15. The escapment of the Pin Carriage is controlled by the Fixed Latch 9018 and the Loose Latch 9019 which engages a double rack in the bottom plate of the Pin Carriage. The Loose Latch 9019 ordinarily engages the inner rack as shown in Figure 15. By means yet to be shown (#32-#33) the Fixed Latch 9018 is moved toward the outer rack while the Loose Latch 9019 still engages the inner rack. When the Fixed Latch 9018 has moved into the space of the outer rack, the Loose Latch 9019 is disengaged from the inner rack. The teeth on the inner and the outer rack are staggered. When the Loose Latch leaves the inner rack, the Pin Carriage follows the pull of Spring 13828 and escapes to left until it is stoped on the outer rack by the Fixed Latch 9018. The result is approximately a one-half step escapement. Then the Loose Latch 9019 is moved back into the range of the inner rack before the Fixed Latch 9018 leaves the outer rack. The second part of the escapement results and the Pin Carriage has then moved into the next order.

#31. Fig. 16. The escapement of the Pin Carriage is imitated by the Value Keys and by some of the Function Keys. It escapes one step per each Value Key depression In division, it escapes (before sensing) to the next to the last position on entry of the dividend,(#34 to #39), and to the last position when the divisor is entered (#42 to #45).

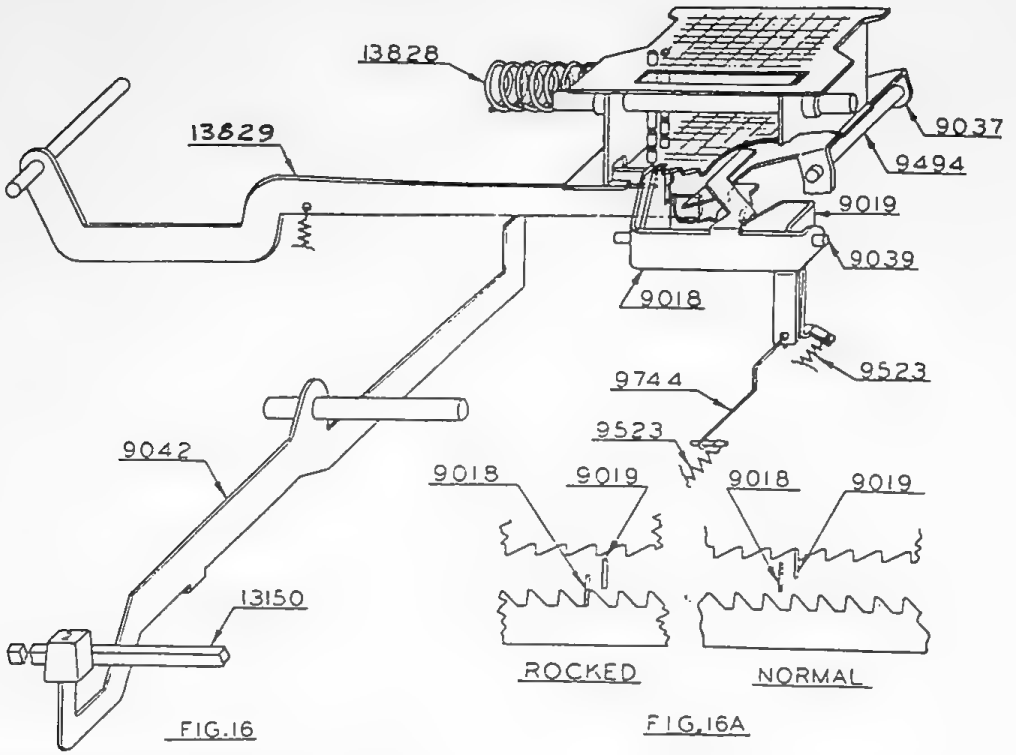


FIG.16

FIG.16A

B. ESCAPEMENT AFTER DEPRESSION OF ANY VALUE KEY

#32. Fig. 16. Depression of the Value Key 9042, will lift the Intermediate Lever 13829. The Intermediate Lever 13829 pushes a value pin up and also lifts the Entry Rocker 9037. As the Entry Rocker 9037 is rocked, it will rock the Fixed Latch 9018, away from the normal position shown in Figure 16A and into the tooth space of the outer rack. The Loose Latch 9019 has a depending tail which is near a similar tail of the Fixed Latch 9018 and restained by another Spring 9523. After the tail of the Fixed Latch has moved a certain distance, it contacts the tail of the Loose Latch 9019 and moves it.

#33. Fig. 16A. The first one-half escapement step will occur when the Fixed Latch 9018 has pushed the Loose Latch 9019 far enough for the tooth on the inner rack to slip off the Loose Latch 9019. The Carriage will be held in the half-step position as long as the Value Key remains depressed. It finishes the escapement step after the Value Key is released. (#15).

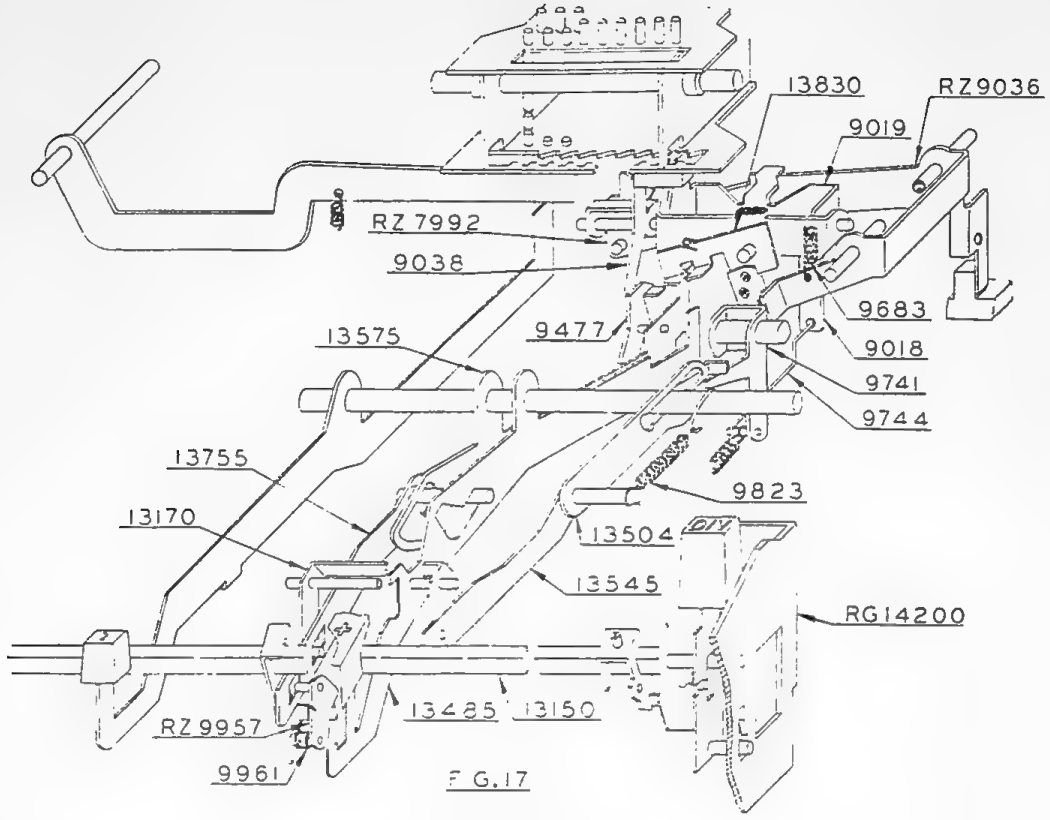


FIG.17

C. DIVISION: DEPRESSION OF ADD KEY

#34. Fig. 17. In simple Addition or Subtraction it is only necessary to sense the Pin Carriage and to enter the value into the registers (#17-#23-#156). The mechanism to start that operation is described in #47, #48.

In Division, after the entry of the dividend, the Pin Carriage is escaped to the next to the last order before it is sensed and the dividend entered into the register dial. The mechanism to accomplish this is shown in full on Figure 17, with the Pin Carriage already in the next to the last position. This can be seen from the position of the Fixed Latch 9018 and the Loose Latch 9019 in the rack slot.

The Division Pre-selection Key having been depressed, has turned the Bar 13150, conditioning the mechanism of the Add Key for dividend entry. When the Pin Carriage is released to go to the next to last position, the Zero-Lever RZ9036 will introduce zeros, (#40) and the Escapement Lock 9038 (#39) will stop the Pin Carriage.

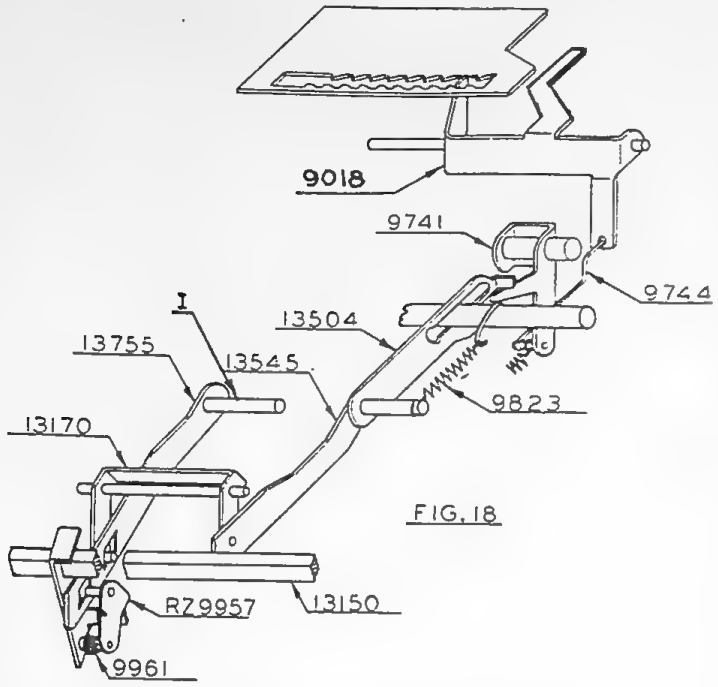


FIG. 18

#35. Fig. 18. The Bar 13150, having been turned counter clockwise by depression of the Division Pre-selection Key, (#000) will tension Spring 9961 on Lever RZ9957. Spring 9961, acting through Lever RZ9957 and a rectangular cut-out in the Control Link 13755, puts pressure on the Control Link 13755. When the first digit of a value is entered, the lower tail of the Fixed Latch 9018 is moved toward the rear of the machine(#32) which takes the Pull Bar 9744 rearward and rocks the Lever 9741 counter clockwise. An arm of Lever 9741, which normally blocks the right ear of Push Bar 13504, is rocked allowing Push Bar 13504 to move rearward under tension of Spring 9823. This also rocks the Connected Bail 13170 counter clockwise. As Bail 13170 rocks it allows Control Link 13755 to move rearward under tension of Spring 9961. As the Control Link 13755 moves rearward it moves pin "I" into the active position shown in Fig. 19.

The cooperation between the studs in the Lever RZ9957 and the Bail 13170 with the Control Bar 13755 and the effect of that cooperation on the depression of the Add-Key is shown in detail in Figs. 18a to 18f.

Fig. 18a goes with Fig. 18d and refers to depression of the Add-Key without previous value entry. The Control Link 13755 does not move, and when the Add-Key is depressed, the wide part in its cut-out prevents the Stud "I" from being affected. Neither the Release Lever 13575 (Figure 19) nor the Release Lever 13475 (Figure 24) move.

Fig. 18b goes with Fig. 18e. When a value has been entered, the Push Bar 13504, (#35), moves forward and the Stud in the Bail 13170 moves the Control Link 13755 until it is stopped by the Stud

in the Lever RZ9957. This brings the Stud "I" under the shoulder in the cut-out of the Add-Key Lever 13485, so that the depression of the Add-Key will now take the Release Lever 13575 along but leave the Release Lever 13575 unaffected. because the Stud "I" is still within the wide part of its cut-out.

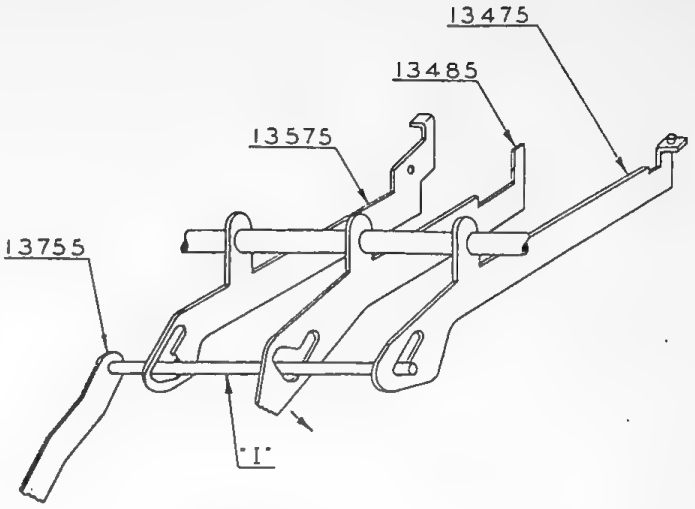


FIG.18D

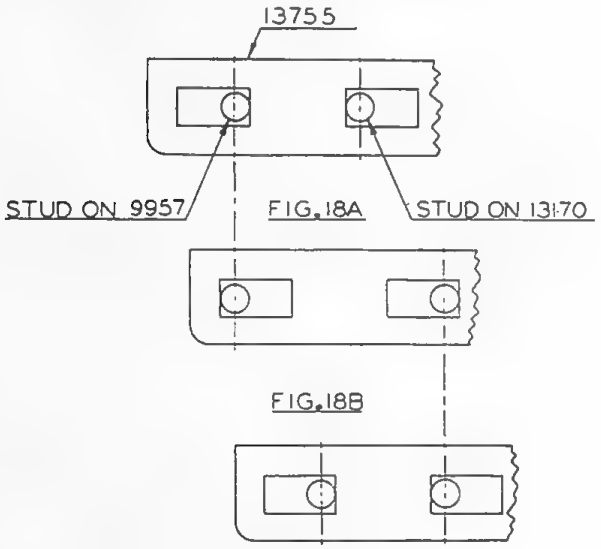


FIG.18C

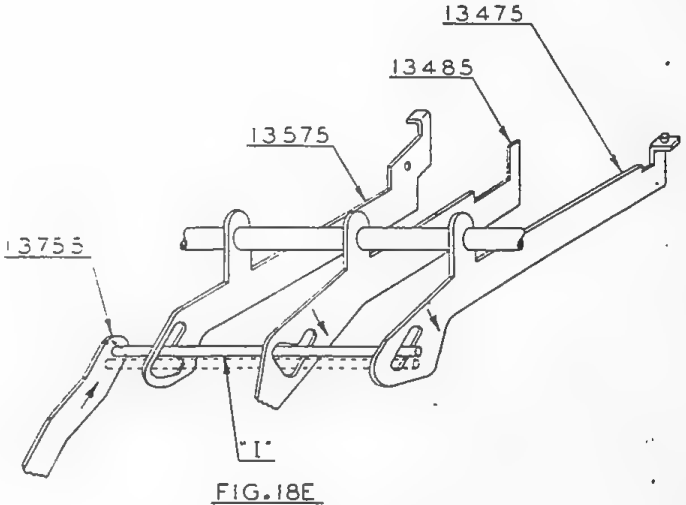


FIG.18E

Fig. 18c goes with Fig. 18f. In this case the Control Link 13755 is moved entirely by the Spring 9961, by way of the Lever RZ9957 and its Stud, and is limited by the Stud in the Bail 13170. With this greater movement of the Control Link 13755, the Stud "I" moves into a position to connect all three Levers as shown in Fig. 18f.

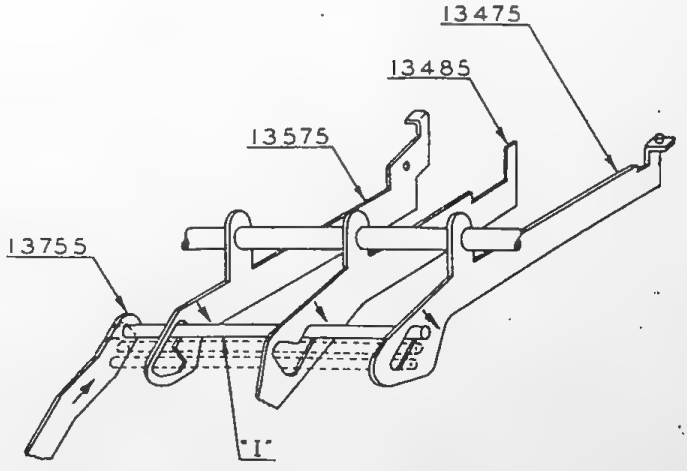
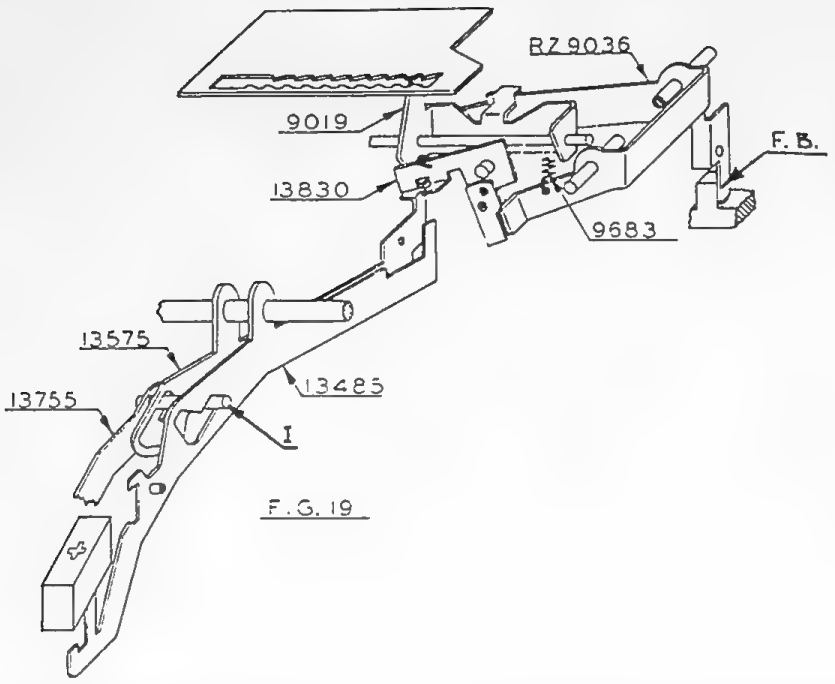


FIG.18F



F.G. 19

#36. Fig. 19. The rearward movement of the Control Link 13755 has brought the pin "I" from the wide portion of the cut-out in the Release Lever 13575 and the Add Key 13485 into a narrow slot which will cause both keys to move as one. Before this actuation, the pin "I" occupied a wide part of cut-out in the Add Key Lever 13485 and Release Lever 13575, in which position each Key can move independent of the other.

#37. Depression of the Add Key will now rock the Release Lever 13575 which will rock the Blocking Latch 13830 in a clockwise direction releasing the Zero Lever RZ9036. This allows the Zero Lever RZ9036 to move in a clockwise direction under tension of Spring 9683, until it is limited by a frame block at "F.B.". The movement of the Loose Latch 9019, also stops at this position.

#38. The Loose Latch 9019 has an arm which overlies the Zero Lever RZ9036. As the Zero Lever RZ9036 is rocked it will rock the Loose Latch 9019, disengaging it from the rack in the bottom plate of the Pin Carriage. The Pin Carriage escapes freely, because the Fixed Latch 9018 is positioned in the middle of the rack slot and is not effective.

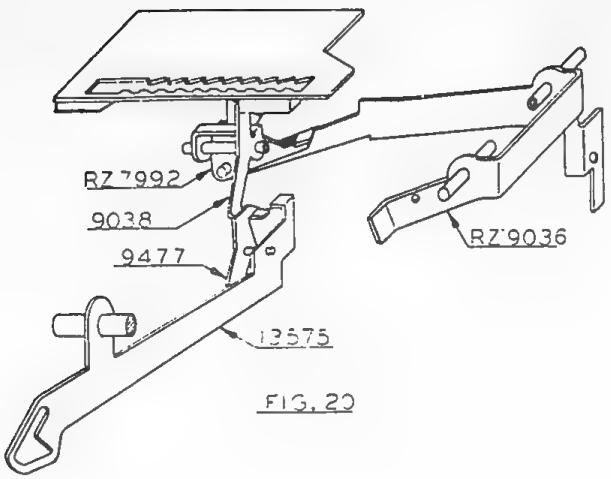


FIG. 20

#39. Fig. 20. The Pin Carriage cannot escape to its leftmost position. It is stopped one order short of the leftmost position because of a block fastened to its bottom plate contacting the Escapement Lock 9038. The Escapement Lock 9038 is positioned in its blocking location by the moveable part 9477 on the Release Lever 13575.

#40. A Zero Latch RZ7992, on the Zero Lever RZ9036 has been raised to a position in which it will cam up all the Zero Pins as the Pin Carriage moves to the next to last position (#38).

#41. At the time the Entry Clutch is engaged, (#54), the Pin Carriage is restored to its home position by the mechanism described in #69. A camming surface on the left forward edge of the Pin Carriage bottom plate engages a similar surface on the Escapement Lock 9038. This rocks the Escapement Lock 9038 counter clockwise so that when the divisor is entered and the I/X Key depressed, the Pin Carriage can escape to the extreme leftmost position.

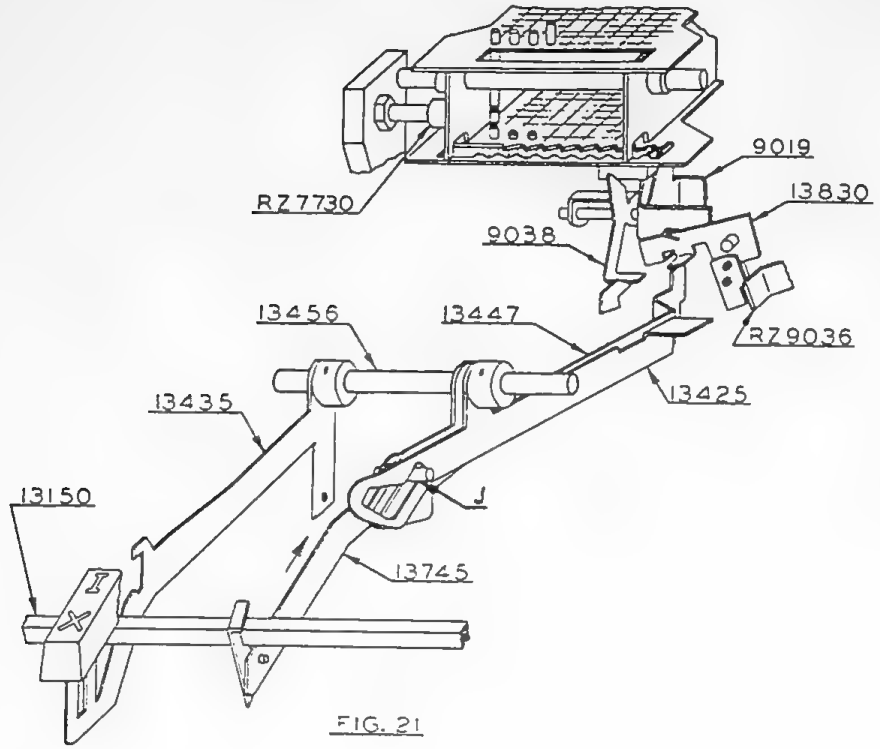


FIG. 21

D. DIVISION: DEPRESSION OF THE I/X-KEY.

#42. Fig. 21. The second factor in division (Divisor) is entered by the I/X-Key (#60). Since the first factor (#37) was entered in the next to leftmost order of the register I, the second factor must be entered in leftmost order, or ninth position.

#43. The depression of the Division Pre-selection Key (#34) has moved the Control Link 13745 rearward and brought its pin "J" into an active position, similar to the pin "I" (#36).

#44. When the I/X Key is depressed, it rocks Shaft 13456. As Lever 13425 on Shaft 13456 rocks, it will, through pin "J", rock the Release Lever 13447 which will lift the Blocking Lever 13830 with the same result as a depression of the Add Key (#37).

#45. The Escapement Lock 9038 having been brought into an inactive position, allows the Pin Carriage to escape until it strikes the Bumper RZ7730 and is stopped in the leftmost position.

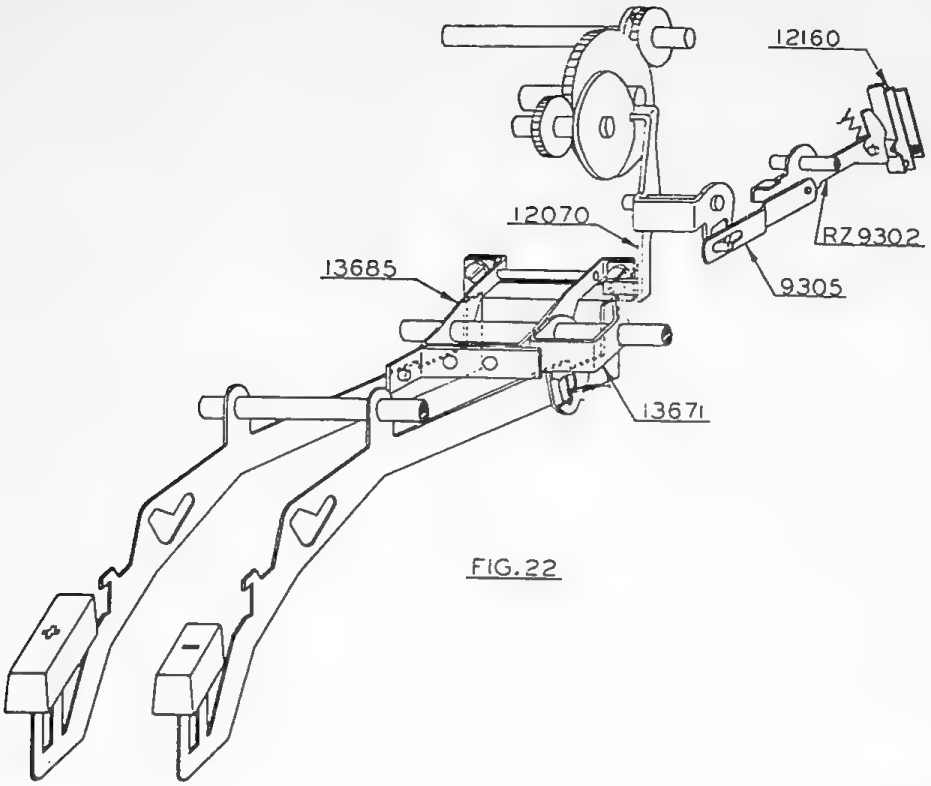


FIG.22

3. THE DRIVE

#46. The Motor Drive, on the left side of the machine, forms a complete sub-assembly. It drives the entry mechanism, the main system, the clearing of the multiplier and, of the calculating mechanism, as well as the back transfer (which is closely related to the clearing mechanism) (#75) .

A. ACTUATION OF ADD OR SUBTRACT KEY WITHOUT PRECEDING VALUE ENTRY

#47. Fig. 22. Depression of the Add Key or Subtract Key will result in the counter clockwise rocking of the Rocker 13685. The Transfer Lever 13671 moves with the Rocker 13685, (#49) , and turns the Clutch Pawl 12070 with its right arm. The movement of the Clutch Pawl 12070 is transmitted to and closes the Start Switch 12160 by the Link 9305 and the Contact Lever RZ9302.

B. ACTUATION OF ADD OR SUBTRACT KEY AFTER VALUE ENTRY

#48. Fig. 23. The first Value Key depressed releases the Push Bar 13504 and allows it to move rearward (#35) .

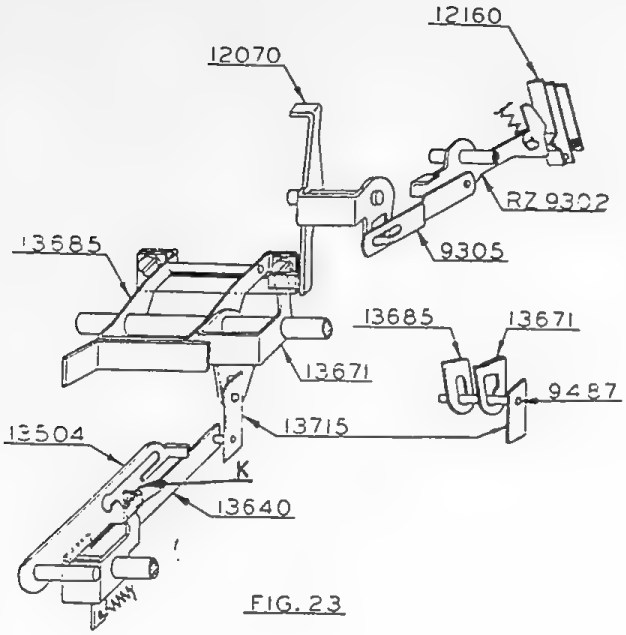


FIG. 23

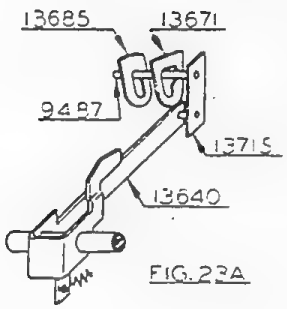


FIG. 23A

The Push Bar 13504 normally restrains the Lever 13640. When the Push Bar 13504 moves rearward, it moves into the range of a slope "K" on the Lever 13640, permitting Lever 13640 to rise.

#49. Fig. 23. A Link 13715 is loosely attached to the Lever 13640. It engages with its Stud 9487, the depending arms of the Rocker 13685 and of the Transfer Lever 13671. When no value is entered, the Stud 9487 is in the narrow part of a cut-out in the Transfer Lever 13671 and connects it with the slot in the Rocker 13685. When the Add or Subtract Key rocks the Rocker 13685, (#47), the Stud 9487 connects the Transfer Lever 13671 with the Rocker 13685 so that they move as a unit.

#50. However, after a value entry, the Lever 13640 has raised the Stud 9487 into the wide part of the cut-out in the Transfer Lever 13671. When the Add or Subtract Key rocks the Rocker 13685 under these circumstances, the Transfer Lever 13671 does not follow because the Stud 9487 is merely moving within the wide part of the cut-out, and therefore the Starting Switch 12160 is not closed.

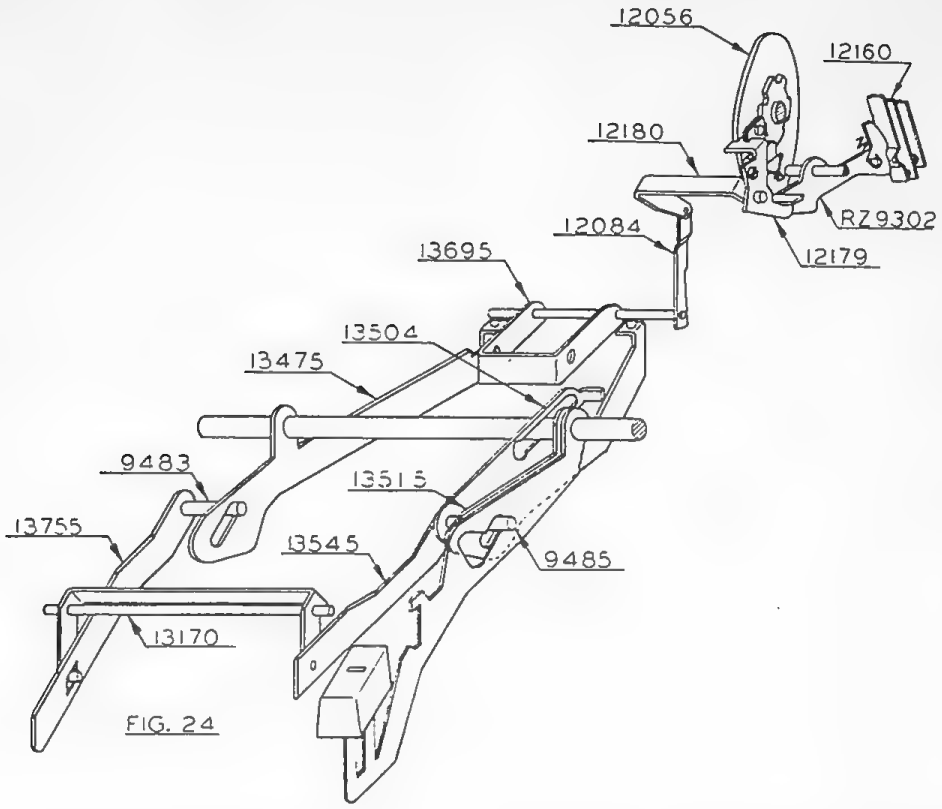


FIG. 24

#51. Fig. 24. The rearward movement of Push Bar 13504 moves Stud 9485 into the narrow part of the opening in the Subtract Key. This connects the Release Lever 13515 with the Subtract Key. Rearward movement of 13504 also moves 13545 rearward rocking 13170 which moves 13755 and Stud 9483 rearward engaging the Release Lever 13475 with the Add Key. The Release Levers 13475 and 13515 terminate in ears from which screws extend against the shaft going through the arms of the Entry Rocker 13695. An Entry Link 12084 connects the shaft in the Entry Rocker 13695 with the Bail 12180 to whose other arm the Entry Clutch Pawl 12179 is adjustably attached. The Entry Clutch Pawl 12179 has an arm which underlies the ear of the Contact Lever RZ9302.

#52. Depression of either the Add Key or the Subtract Key with value entry lifts the Entry Rocker 13695, rocks the Bail 12180, and disengages the Entry Clutch Pawl 12179 which closes the Start Switch 12160.

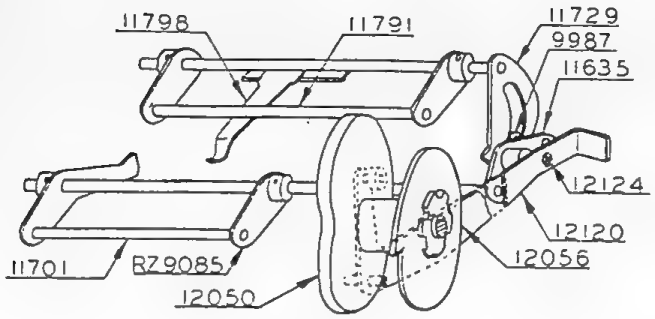


FIG. 25

#53. Depression of the Add or Subtract Key without a value entry, disengages the Clutch Pawl 12070, (Fig. 22). With a value entry it disengages the Entry Clutch Pawl 12179 and later the Clutch Pawl 12070 will also be disengaged, but only after the value in the Pin Carriage has been sensed.

#54. Fig. 25. The Entry Clutch is engaged and causes a complete revolution of the Entry Clutch Disc 12056 and of the Guide Cam 12050 which is connected to the Entry Clutch Disc 12056. The Swing Bar Lever 12120 engages the Guide Cam 12050 with an internal roller and is positively guided during the revolution of the Entry Clutch Disc 12056. The movement of the Swing Bar Lever 12120 is transmitted through the Drive Lever 11635 and the Adjustable Screw 12124 to the Arms RZ9085 and the Swing Bar 11701 (#17).

#55. The movement of the Drive Lever 11635 is also used to relieve the tension of the Spring Comb 11798. A Roller 9987 engages the Slot Lever 11729, which, when it rocks, moves the shaft controlling the Spring Comb 11798 through the Bar 11791 (#18).

#56. The cycle of the Entry Clutch has so far resulted in the sensing of the Pin Carriage and the setting of the System Segments 11415, (#17), and no value has as yet appeared in register III.

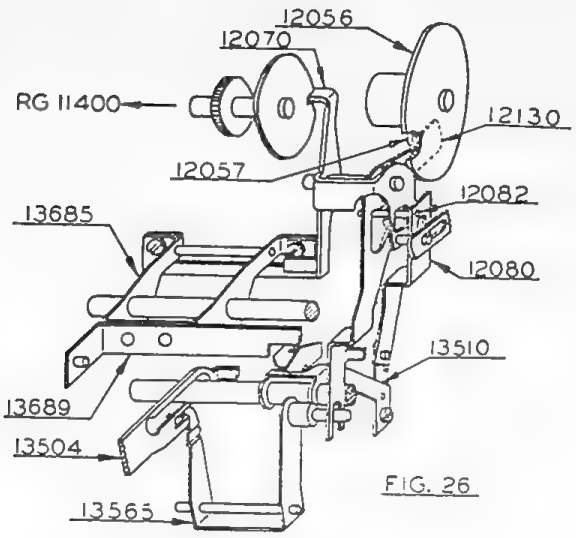


FIG. 26

#57. Fig. 26. In order to enter the value into the register III, the Clutch Pawl 12070 must be disengaged. A Roller 12057 on the Entry Clutch Disc 12056 strikes the Impulse Lever 12130.

#58. The Rocker 13685 has been previously depressed, (#47), and by its Connected Lever 13689, has rocked the Bail 13510, so that Stud 12082 on the Connecting Link 12080 has been brought down into the effective area of a cut-out in the Impulse Lever 12130. Since the Stud 12082 passes through a hole in the Clutch Pawl 12070, the Clutch Pawl 12070 must follow the movement of the Impulse Lever 12130 and release the Main System RG11400. The Main System RG11400 rotates as described in #22 . It will continue to rotate as long as the Add or Subtract Key remains depressed.

#59. The Impulse Lever 12130 has also returned the Push Link 13504 to its normal position by rocking the Setting Bail 13565. This has also returned the Lever 13460 to its normal position and thus returned the Stud 9487 to its position in the narrow portion of the cut-out in the Transfer Lever 13671 (Fig. 23, #49).

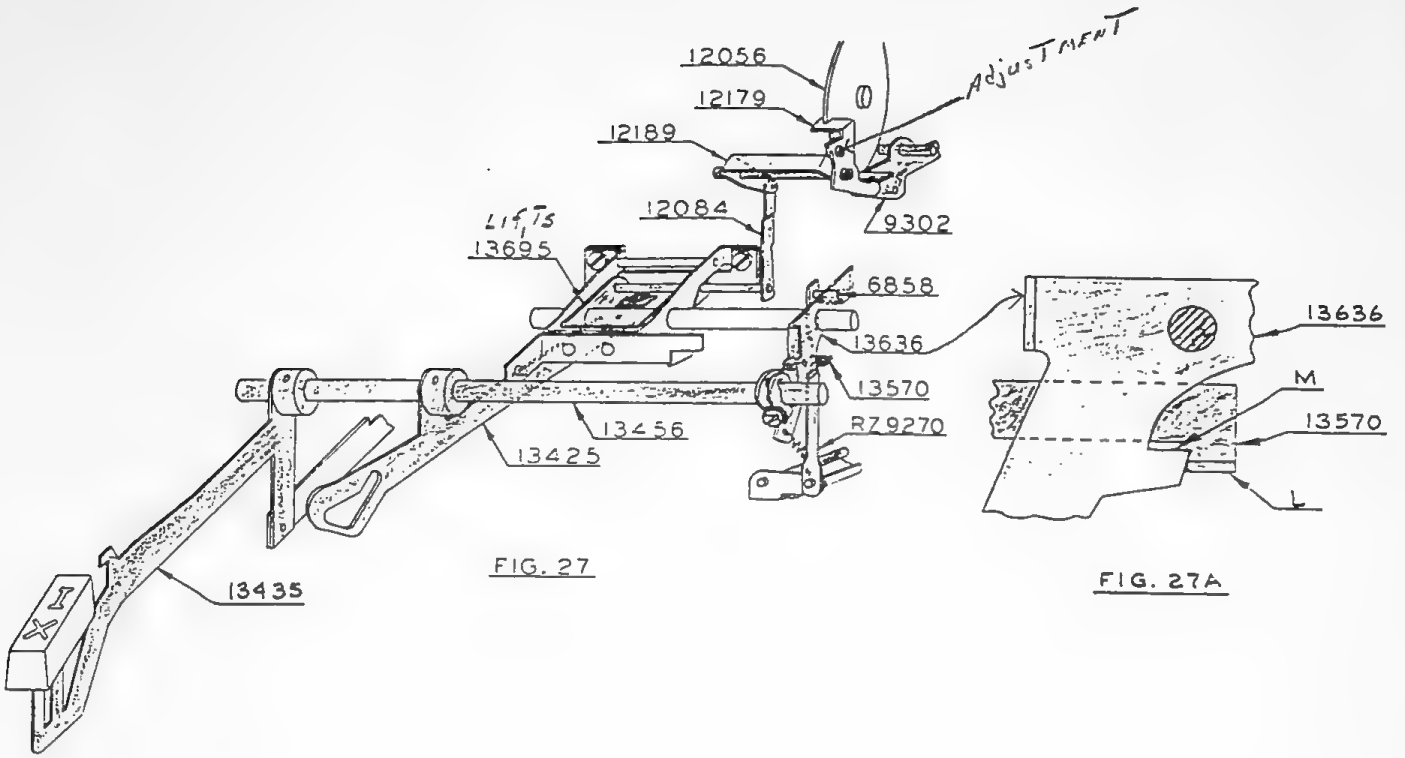


FIG. 27

FIG. 27A

C. ACTUATION OF THE I/X-KEY

#60. If no value key has been depressed, the I/X-Key actuates the drive mechanism, but not the Main System, and clears the multiplier mechanism. (#64).

#61. Fig. 27. The I/X-Key Lever 13435 and the Lever 13425 are both fastened to the Shaft 13456. Depression of the I/X-Key Lever 13435 lifts, through Lever 13425, the Entry Rocker 13695 and disengages the Entry Clutch Pawl 12179, and closes the Starting Switch as described previously (#52).

#62. The Rocker 13685 has not been affected and the Stud 12082 not moved, (Fig. 26, #58); therefore, the Impulse Lever 12130 cannot disengage the Main System Clutch Pawl 12070.

#63. Fig. 27A. The I/X-Key is held depressed during the cycle because the ear "L" of the Holding Arm 13570 has been moved up and is held by the nose "M" of the spring urged Catching Lever 13636 until the Pull Bar RZ9270 releases it by its Stud 6858 (Fig. 27).

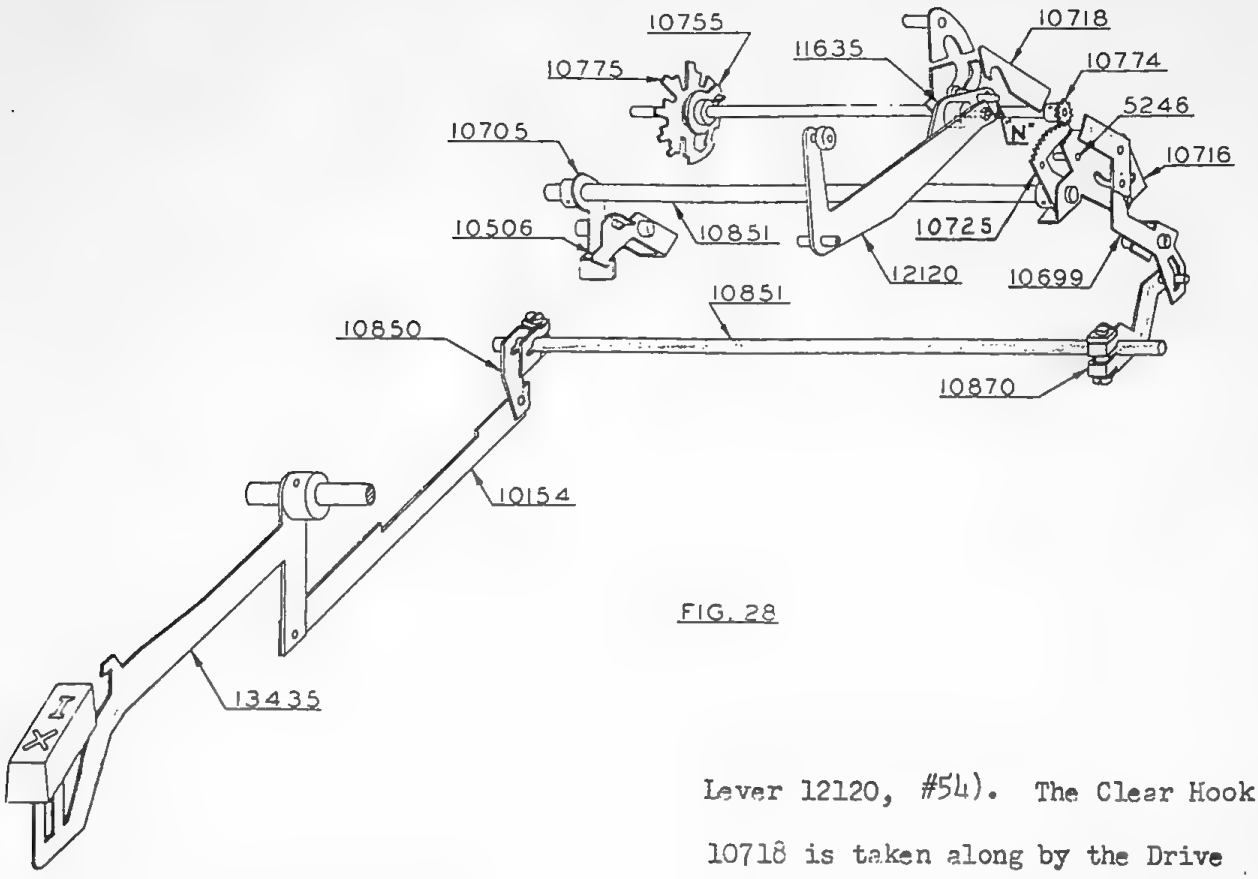


FIG. 28

#64. Fig. 28. Depression of the I/X-Key clears the multiplier mechanism of a preceding entry. For this purpose, the spring urged Clear Hook 10718, which pivots on the Rocker 10716, is turned counter clockwise by cooperation of the Lever 10699, the Brackets 10870 and 10850,(fixed on Shaft 10851), the Link 10154, and the I/X-Key Lever 13435. This movement brings the Clear Hook 10718 into the range of Stud "N" on the Drive Lever 11635 (actuated by the Swing Bar Lever 12120, #54). The Clear Hook 10718 is taken along by the Drive Lever 11635 and swings the Rocker 10716 with it. The Stud 5246, on the Rocker 10716 contacts the Gear Sector 10725 which drives the Pinion 10774 and its shaft clockwise. The Clear Finger 10755 (fixed on the shaft) contacts an ear on the Step Disc 10775 (loose on shaft but controlled by a spring comb) and turns it to its zero position. The Sector Latch 10506 latches the Lever 10705, holding the Gear Sector 10725 in the normal position.

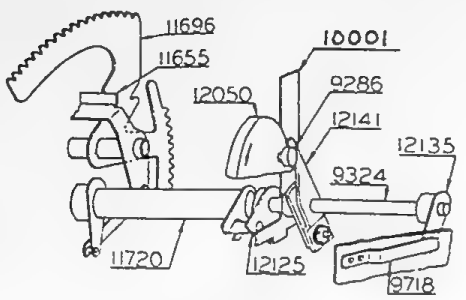


FIG. 29

D. CLEAR BAIL FOR THE SENSING SYSTEM

#65. Fig. 29. The Entry Segments 11696 must be cleared before every new entry. This clearance, referred to in #16, is accomplished early in the actuating cycle of the drive, when the Roller 9286 on the Guide Cam 12050 strikes the Restore Crank 12141. The Restore Crank 12141 drives the Shaft 9324 which drives the Shaft 11720 which drives the Clear Bail 11655 through a conventional linkage.

#66. The Clear Bail 11655 will be driven for an instant only, moving the Entry Segments 11696 to their zero positions. Thereafter, it may be pushed back by the Entry Segments 11696 which are actuated in a later part of the entry cycle when the Sensing Systems advance against the Pins in the Pin Carriage (#17).

#67. The Dials of the register I reflect the position of the Entry Segments 11696 at all times (see #18). The position of the Clear Bail 11655 indicates whether the register I is clear or not, because the Clear Bail 11655 cannot be in the zero position if even one Entry Segment 11696 holds its respective Dial in the register I in a position other than zero. This circumstance is utilized to control the Back Transfer Key (#75).

#68. Fig. 29. A Blocking Arm 12125 is attached to the Shaft 9324. The Back Transfer Pendulum 10001, which rises upon depression of the Back Transfer Key, is so related to the Blocking Arm 12125 that it can rise only when the Blocking Arm 12125 indicates that the Clear Bail 11655 is in the zero position. Back Transfer is therefore impossible when the register I contains a value.

The Clear Bail 11655 is held in its zero position by a 5 millimeter diameter ball which is retained by a Leaf Spring 9718. The ball fits in a hole in the frame and engages a hole in Arm 12135, on the Shaft 9324.

E. PIN CARRIAGE RETURN

#69. Fig. 30. The return of the Pin Carriage is controlled by the Guide Cam 12050. A Roller 9286 on the Guide Cam 12050 contacts the Pin Carriage Restore Lever 12090 camming it down and, through the Push Bar RZ9270 (#63), the Pin Carriage Clear Rocker 13010, and the Link 9418, pulls the Pin Carriage back to its normal position.

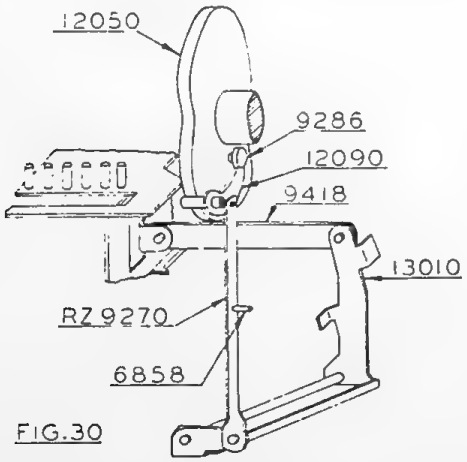


FIG.30

F. CLEARING THE CALCULATING CARRIAGE

#70. Fig. 31. The Starting Switch 12160

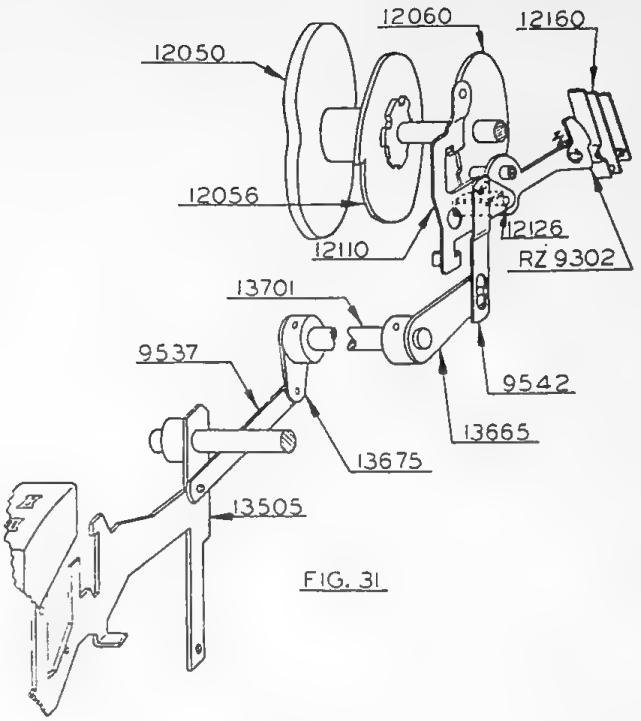


FIG. 31

is closed as follows: Depression of the II/III-Key Lever 13505, through Link 9537, Arm 13675, Shaft 13701, Arm 13665, and Link 9542, rocks the Carriage Clear Pawl 12110 counter clockwise which engages the Carriage Clear Clutch 12060. The Carriage Clear Pawl 12110 has a Stud 12126 which engages and rotates the Contact Lever RZ9302 (#47), which closes the Start Switch 12160. The registers II and III are cleared by the cycle of the Carriage Clear Clutch 12060 in the following way:

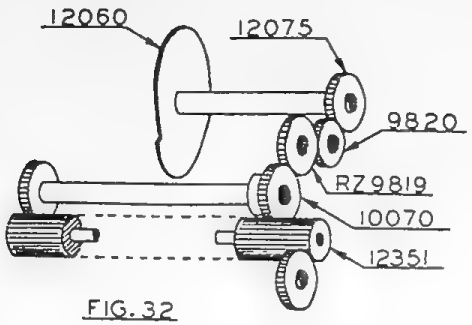


FIG. 32

#71. Fig. 32. The revolution of the Carriage Clear Clutch 12060 is transmitted through Gear 12075, Gear 9820, Gear RZ9819, and Double Gear 10070, to the long Clear Gear 12351 in the Carriage regardless of the position of the Carriage, and clears the registers II and III, as described in #28.

#72. Fig. 33. The II/III-Key remains depressed until the Stud 9282 on the Carriage Clear Clutch 12060 rocks the Release Lever RZ9334 and releases,

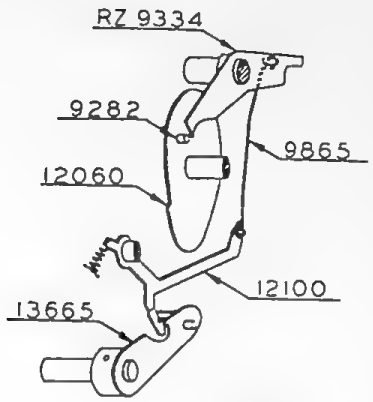


FIG. 33

through wire 9865, the engagement of the II/III-Key Latch 12100 with the Arm 13665. (#70).

#73. Fig. 34. If the II-Key is depressed, the Stud 13507 will also depress the II/III-Key. The actuation is the same as that described in #70, except that: The II-Key Stem 13180, by Arm 13125, Shaft 13121, Hook 13130, and Bellcrank

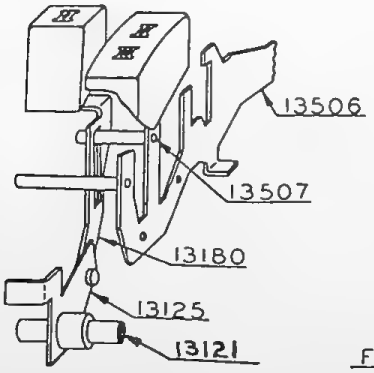
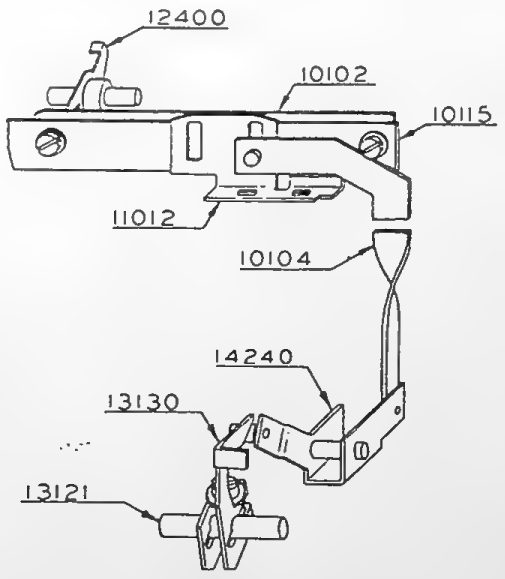


FIG. 34



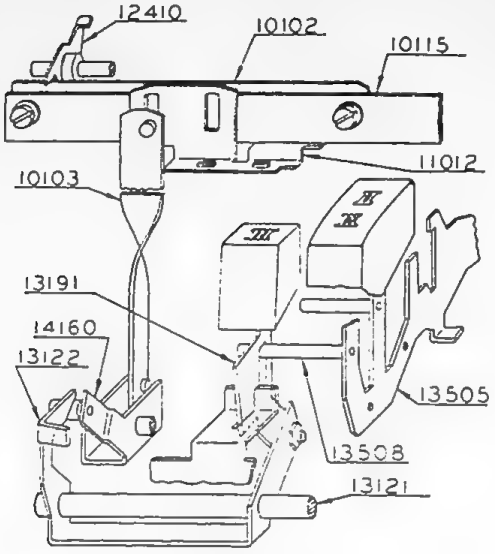


FIG. 35

14240, lifts Link 10104. Link 10104, guided in a slot of the Bracket 11012, lifts the right end of the Adjustable Bar 10102 and rocks Disabling Lever 12400, disengaging the clutch in the Carriage which prevents the clearing of register III (#000). The Adjustable Bar 10102 is long enough to underlie the Disabling Lever 12400 in all positions of the Carriage.

#74. Fig. 35. Depression of the III-Key will also depress the II/III-Key by Stud 13508. The III-Key Stem 13191 rocks the Bail 13122 forcing Lever 14160 to lift Link 10103. The left end of the Adjustable Bar 10102 is lifted, rocking the Disabling Lever 12410, disabling the clutch in the Carriage and thereby prevents the clearing of register II.

G. BACK TRANSFER

#75. Fig. 36. As described in #68, the Sensing Pendulum 10001 permits depression of the Back Transfer Key only when the register I is clear. Depression of the Back Transfer Key Lever 13506C moves Link 10002 up, which rocks the Back Transfer Arm 11770 whose Block 11778 releases the thumb "A" of the spring-actuated Bail 12150. Bail 12150 engages in

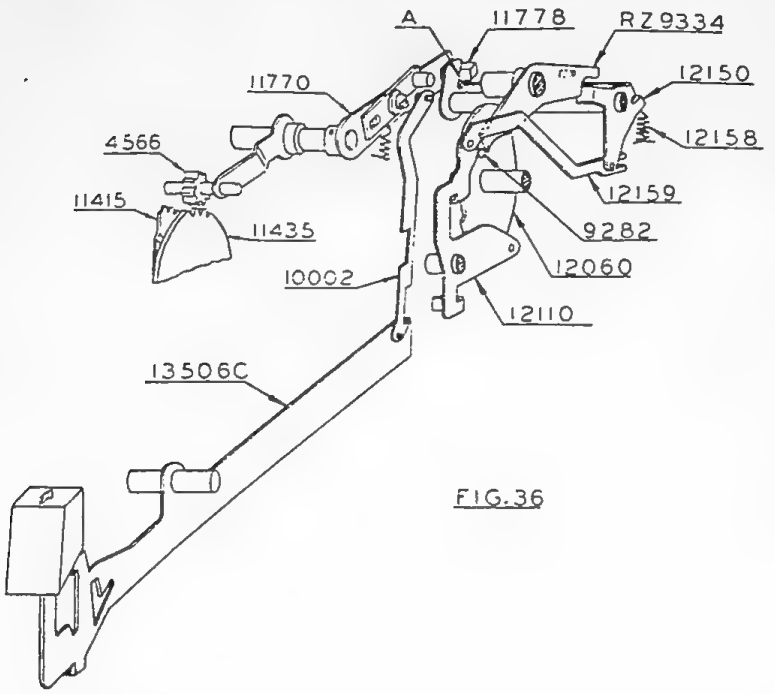


FIG.36

normal position the bottom of a fork on the Starting Link 12159 which is pivoted on the Carriage Clear Pawl 12110 and starts the clearing operation at once.

#76. When the Back Transfer Arm 11770 has rocked, it moves the Back Transfer Gears 4566 from engagement with a locking shaft and into engagement with the System Gear 11435 and the respective System Segment 11415. When the clearing operation starts, the System Gear 11435 (which must turn in any clearing operation of the register III) is joined with the System Segment 11415. According to previous explanations (#18) the register I must reflect the position of the System Segment 11415. Thus, the clearing transfers the value from register III to register I. The thumb "A" of the Bail 12150 had placed itself under the Block 11778, holding the Back Transfer Gears 4566 securely engaged. After every clearing cycle, it is moved back to its normal position by the Pin 9282 (#72) which forces the Release Lever RZ9334 to restore the Bail 12150.

4. AUTOMATIC MULTIPLICATION

PRELIMINARY REMARKS

In order to understand the following description of automatic multiplication in the Tenkeymatic, it is necessary to understand the principle of short-cut multiplication.

#77. In solving multiplication problems with pencil and paper, for example

456 x 456

we perform a series of mental multiplications, putting down only the intermediate products and making sure that they are staggered. We then add the intermediate products thus,

```
                456
              x 456
inter-    1st---->2736
mediate-< 2nd---->2280 <----staggered
products  3rd---->1824
             ------
             207936   answer
```

#78. The Tenkeymatic, as well as all other mechanical calculators, cannot directly multiply, (as shown in paragraph #77), by forming intermediate products. However, calculators without a short-cutting mechanism solve the problem given above in a similar way, as follows:

```
  456
  456      FIRST GROUP
  456      6 times added
  456
  456      (6 x 456 = 2736)
  456
-----------FIRST SHIFT TO NEXT FULL ORDER
 456
 456       SECOND GROUP
 456       5 times added
 456
 456
-----------SECOND SHIFT TO NEXT FULL ORDER
 456
 456       THIRD GROUP
 456       4 times added
 456
------
207936     Answer
```

The problem in multiplication is reduced to a problem of addition and shifting of the Carriage.

#79. Observe that the first group in #78 represents the same value as the first intermediate product in #77. The number "456" has been added six times. If the problem had been "456 x 9", it would have been added nine times or nine cycles.

#80. Now observe that the number of calculating cycles, which increased as the multiplier increased (six cycles for "6", nine cycles for "9") does not

increase when we increase the multiplier still more. The problem

456 x 10 = 4560

requires only one cycle. On paper we tag on a zero. In a calculator, we just shift the Carriage one order to the right and enter the number "456" once.

#81. Now referring back to the original problem 456 x 456, observe further that as far as the answer is concerned, it makes no difference whether we ADD the number "456" six times to get 2736 (the first intermediate product of #77, and the sum of the first group of #78), or whether we MULTIPLY by "10" by shifting the carriage and adding once, and then SUBTRACT FOUR TIMES, thus:

```
 4560
- 456
- 456
- 456
- 456
------
 2736
```

We obtain the same answer, i.e. "2736", whether we multiply by "6" or whether we multiply by "10 minus 4".

#82. This, then, is the method of multiplication in the Tenkeymatic: If we multiply by "1", "2", "3", "4", or "5", we add, as in ordinary calculators, one, twice, three times etc. If we multiply by "6", "7", "8", or "9", we use the short-cut multiplication in which we "MULTIPLY BY TEN" and SUBTRACT, as the case may be, four times, three times, etc. The purpose of short-cut multiplication is to save time by reducing the required number of cycles. If we multiply by "6" we save one cycle, by "7" three cycles, by "8" five cycles, by "9" seven cycles. When we have a combination multiplier, as "456", we use both ordinary multiplication and short-cut multiplication. Thus, the first group in #78 will be short-cut, the two others ordinary multiplication.

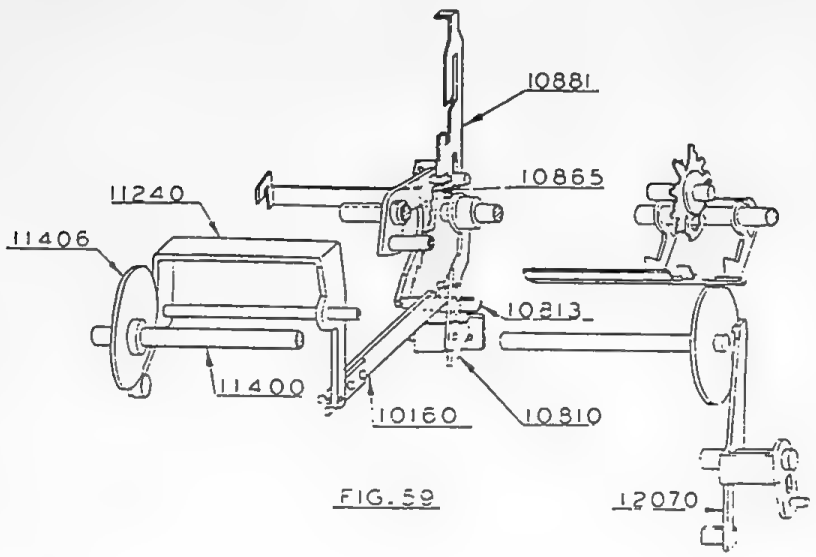


FIG. 59

#119. Fig. 59. The cycling Main System acts through Cam 11406, the Cycle Bail 11240, the Link 10160, the Escapement Rocker 10810 and the Transport Pawl 10813 to move the Value Segment 10865 one increment past its normal position. This movement of the Value Segment 10865 forces the Control Slide 10881 up. When the Control Link 10881 rises, it moves against the Stud on the arm of the Correction Latch 10528 (Fig. 59A) and turns the Correction Latch 10528 counter clockwise until it releases the ear of the Ear Rocker 10830. Moving still further it permits the Holding Latch 10779 to snap up and engage. The effect is that the Sensing Fingers 10818 and 10835 which have been held by the Correction Latch 10528 by way of the Ear Rocker 10830, are now freed for sensing the next order Step Disc 10775.

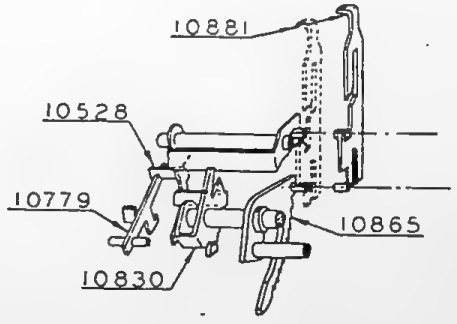


FIG. 59A

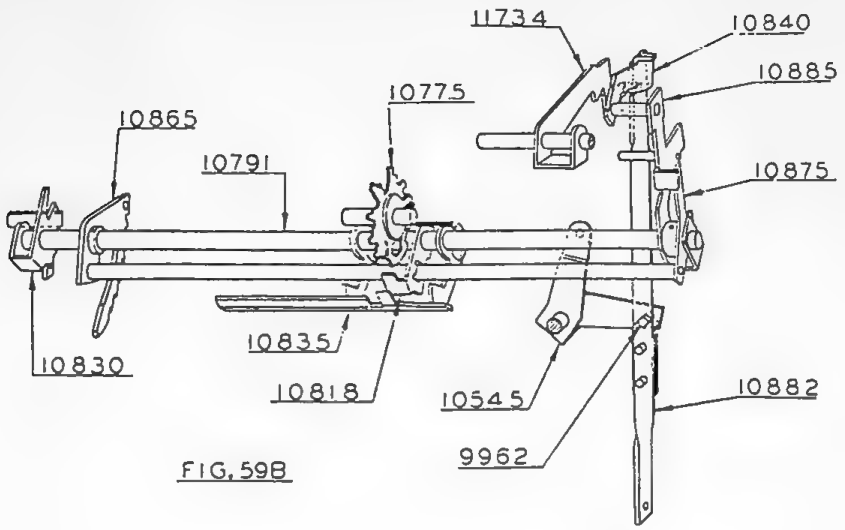


FIG. 59B

Fig. 59B. The additional lifting of the Value Segment 10865 prevents a further shift of the Sensing Fingers 10818 and 10835 and the Calculating Carriage (#112 and #113). This is accomplished by the Lever 10875 on Shaft 10791 (which also carries the Sensing Fingers 10818 and 10835). The additional movement of the Value Segment 10865 moves the Lever 10875 against an ear on the Enabling Lever 10885, removing the Enabling Lever 10885 from the notch in the Bar 10882. When the Lifting Lever 11734 is raised by the Stud 10668 on the Shift Disc 10665 it cannot lift the Bar 10882 as described in #111. Thus the shift of the Sensing Fingers 10818 and 10835 and of the Calculating Carriage are prevented.

L. STOPPING THE MACHINE

#120a. Fig. 60A. When the Ear "Z" and the Ear "ZZ" of the Plus-Minus Finger 10835 are unable to sense a value, the machine will be stopped. This will occur when all Step Discs 10775 have been sensed or when the Step Disc 10775 being sensed by Ear "Z" is zero and all remaining Step Discs 10775 to the left are zero, including the Left Side Plate. (#94).

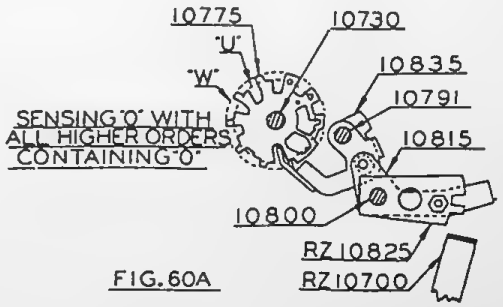


FIG. 60A

#120b. Fig. 60B. Every sensing operation determines two things: First, whether a short-cut value ("6" to "9") is contained in the order being sensed. Second, if the sensed order contains "0", whether any higher order contains a value other than "0".

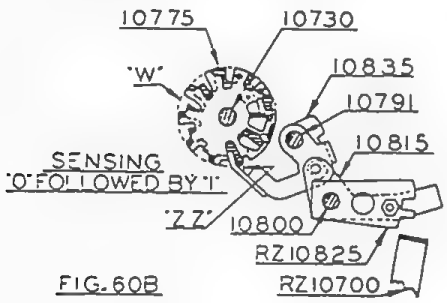


FIG.60B

#120c. The active order is sensed by the Ear "Z". For values of "6" to "9", the Ear "Z" will be blocked by one of the surfaces "W" (#107). For values of "1" to "5", the Ear "Z" will be blocked by one of the surfaces "U" (#107).

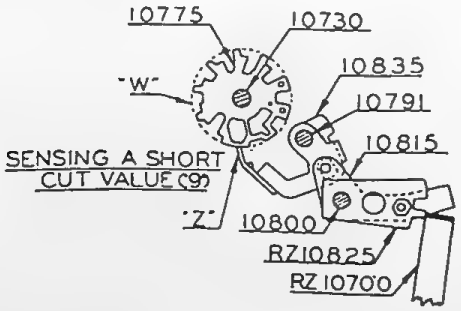


FIG.60C

If not blocked by either surface "W" or "U", the Ear "Z" will continue into the zero notch.

#120d. If the Ear "Z" in the active order senses zero, the Ear "ZZ" takes over. If any Step Disc 10775 to the left contains a value, as for example "1", (Fig. 60B), the Ear "ZZ" will be stopped at the surface "W" of that higher Step Disc. The machine will not be stopped, but a shift will be initiated. This could happen several times if the value "100001" had been keyed in.

#120e. If there is no value contained in any higher Step Disc 10775, the Ear "ZZ" will not be blocked. The Plus-Minus Finger 10835 will rock into its deepest position in the zero notch. (Fig. 60A).

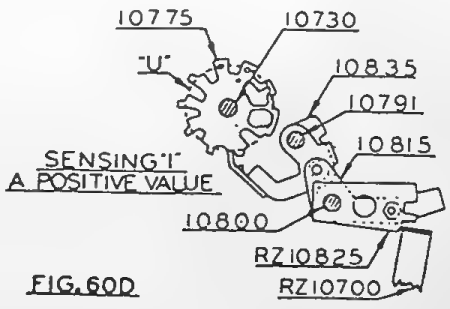


FIG.60D

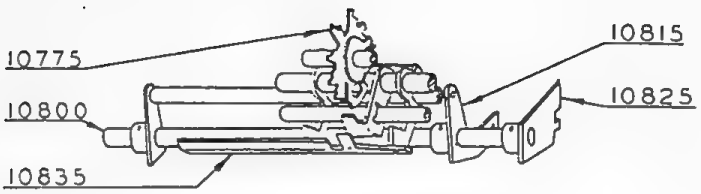


FIG. 61

#121. Fig. 61. The Lever 10815 and the Rocker 10825 on the Zero Shaft 10800 are affected by the movement of the Plus-Minus Finger 10835, and are rocked counter clockwise. If the Plus-Minus Finger 10835 senses any value but zero, the Lever 10815 and Rocker 10825 will be rocked only a short distance. When the Plus-Minus Finger 10835 senses the value "0" in the active order while there are values in orders to the left (#120d), the Lever 10815 and Rocker 10825 are rocked further. When the active order and the orders to the left contain a zero, the Lever 10815 and Rocker 10825 rock the greatest distance.

#122. The position of the Shift Rocker 10825 helps determine the movement of the Calculating Carriage (#108). When rocked for a zero sensing, it is lifted above the Scanner 10700 to represent

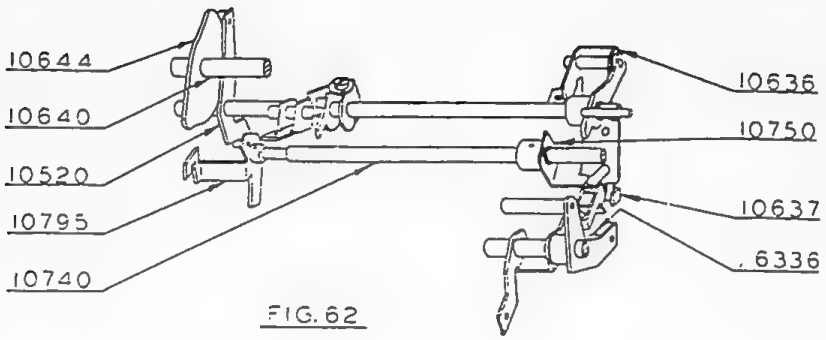


FIG. 62

the same as a non-short cut value position. The amount it is lifted is great enough so that even though the NEG-Key is depressed (#130), the Scanner 10700 still scans as a short cut value position.

#123. Fig. 62. When the Lever 10815 rocks its greatest amount, its Stud 6336 contacts a lower surface of the Lever 10636. The Lever 10636 is controlled from the Multiplier Control Shaft 10640, through Cam 10644, Follower 10520, Catch 10795, Shaft 10740, by the Claw 10750. It is rocked once for every cycle of the Shaft 10640 because the Follower 10520 is moved by the Cam 10644. This rocking occurs after the Stud 6336 on Lever 10815 has moved up, and places the Ear 10637 under the Stud 6336 if the Lever 10815 has rocked far enough (#121).

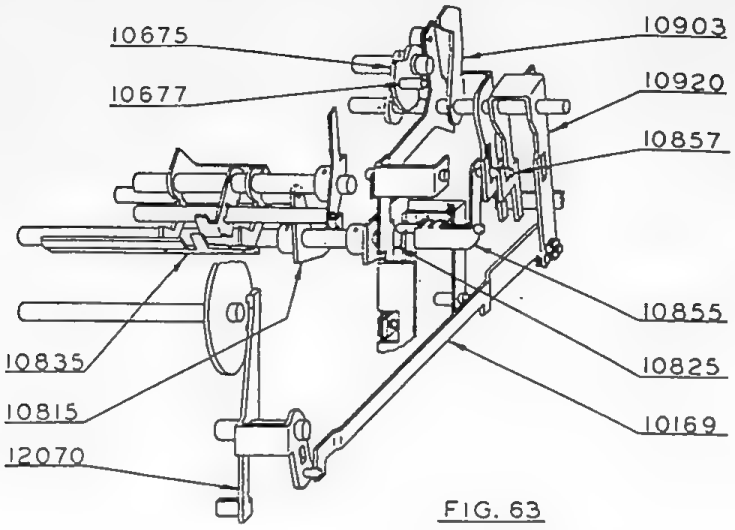


FIG. 63

#124. Fig. 63. In order to prevent the Main System from starting when all zeros are sensed, the Stud 10857, (which reflects the movement of the Plus-Minus Sensing Finger 10835), moves out of the open slot in the Lever 10920. Then when the Stud 10677 on the Shift Control Cam 10675 rocks the Lever 10903, the Lever 10920 does not follow and the Clutch Pawl 12070 remains unaffected (#99).

#125. Fig. 64. When the Plus-Minus Finger is returned to its normal position by Cam 10643, the Stud 6336 contacts the Ear 10637 and pulls the Lever 10636 down. The downward movement of the Lever 10636 rocks the Connected Lever 10625 which contacts the Stud 9329 of the Enabling Lever 10885. This causes the withdrawal of the Lever 10840 from the notch in the Bar 10882, as described in #119. The

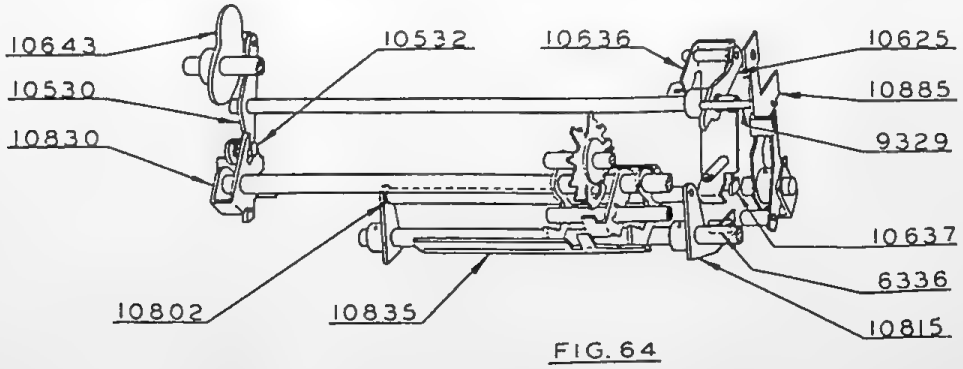


FIG. 64

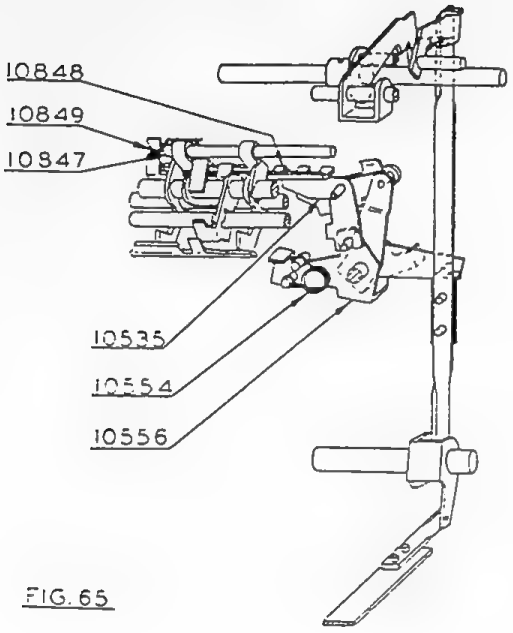


FIG. 65

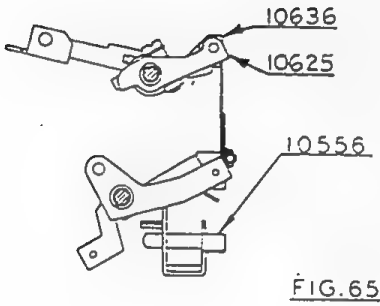


FIG. 65A

revolution of the Multiplier Control Shaft 10640 cannot therefore result in a shift of the Calculating Carriage. The Shifting of the Sensing Fingers is likewise terminated (#111-#112). #126. Fig. 65. According to #113, the Comb 10848 is held in its various escaped positions by the Pawl 10535. The Pawl 10535 is held up by the Rocking Spring 10554 and re-engages the Comb 10848 under spring pressure after every escapement step of the Comb 10848. It is only the Pawl 10535 that holds the Comb 10848 in a escaped position. During the down movement of the Lever 10636, (#125), the lower end strikes the ear of the Cocking Lever 10556, Figure 65A, (which had been set during the movement of the Bellcrank 10545, #112), and disengages the Pawl 10535 which by its pin and fork connection must follow the movement of the Cocking Lever 10556. The Comb 10848 is pulled back by its Spring 10849. Since the Sensing Fingers 10818 and 10835 are controlled by the Comb 10848, they, too, move back to the initial position.

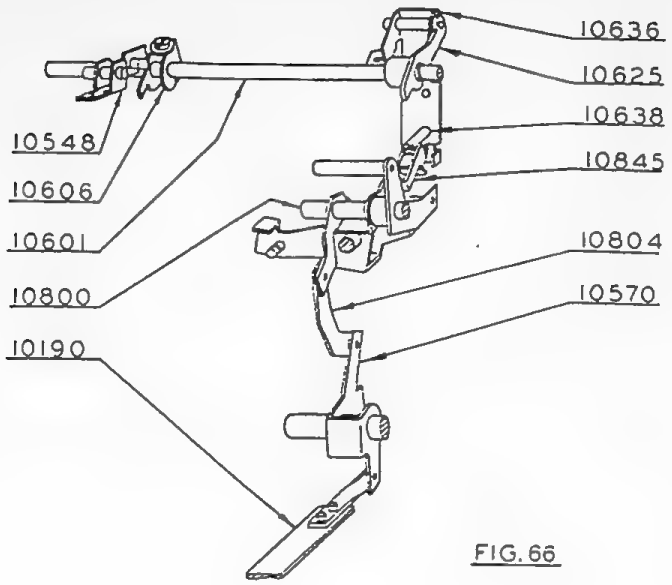


FIG. 66

#127. Fig. 66. The Lever 10636 also initiates the return of the Calculating Carriage. As the Lever 10636 moves down, a Stud 10638, which is on the inside of 10636, contacts the ear of the Lever 10845 on the Zero Shaft 10800. The Lever 10845 rocks the Bellcrank 10570 by means of the Link 10804. This causes a movement of the Link 10190 which results in the return shift of the Calculating Carriage as described in #113.

#128. The movement of the Lever 10636 also releases the Multiplier Clutch Pawl 10540 which had been held by engagement of the Latch 10548 on the Shaft 10601 (#91). The Lever 10636 is supported by the Lever 10625 which is pinned to Shaft 10601. When the Lever 10636 moves down (#125), the Clamp Arm 10606 rocks and contacts the ear of the Latch 10548 which breaks the engagement of the Latch 10548. The Multiplier Clutch Pawl 10507 can now engage the Disc 10645 and stop further movement of the Multiplier Control Shaft 10640 (#98-#99).

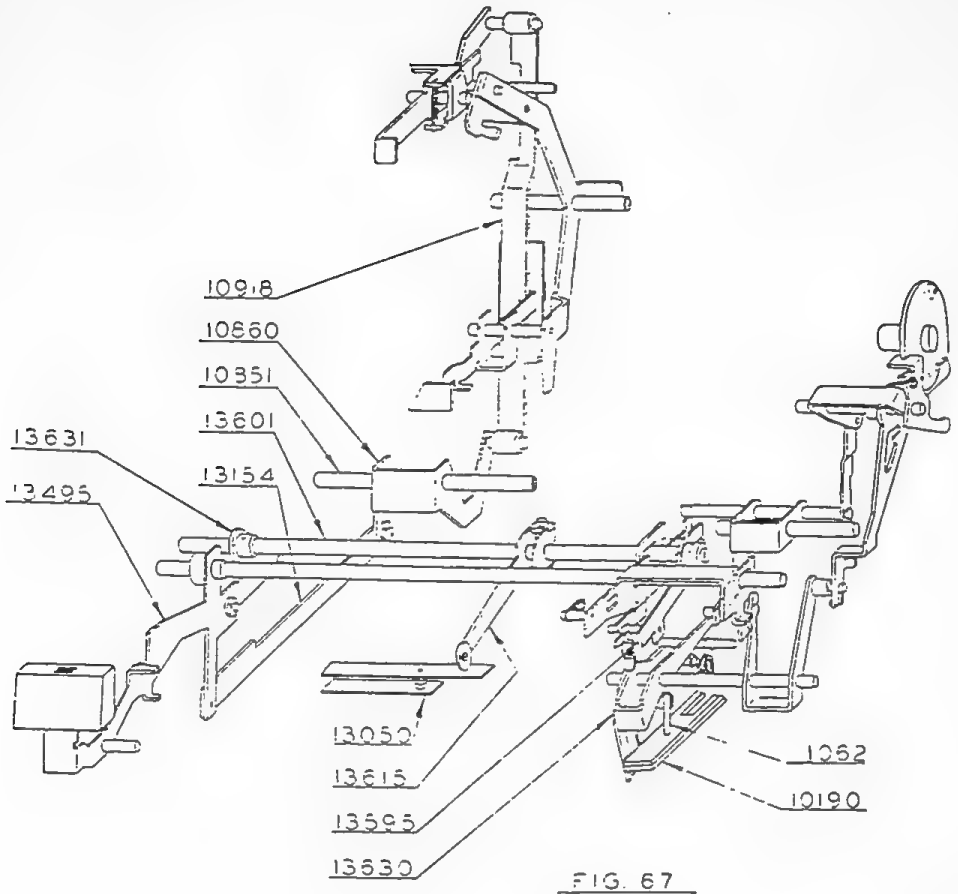


FIG. 67

#129. Fig. 67. In order that all function keys are blocked during Multiplication, the Lever 13630 (#87), is not released until after the return of the Calculator Carriage has begun. The release is effected by the Bellcrank 10570 (#127). The Stud 1062 on Link 10190 rocks Lever 13630 which releases Arm 13595. The final release occurs when the Multiplier Clutch Pawl 10540 is released (#128). Only then will the Bar 10918 be permitted to slip off the Angle 10503 on the frame, (#91), and allow the Equals-Key to come up.

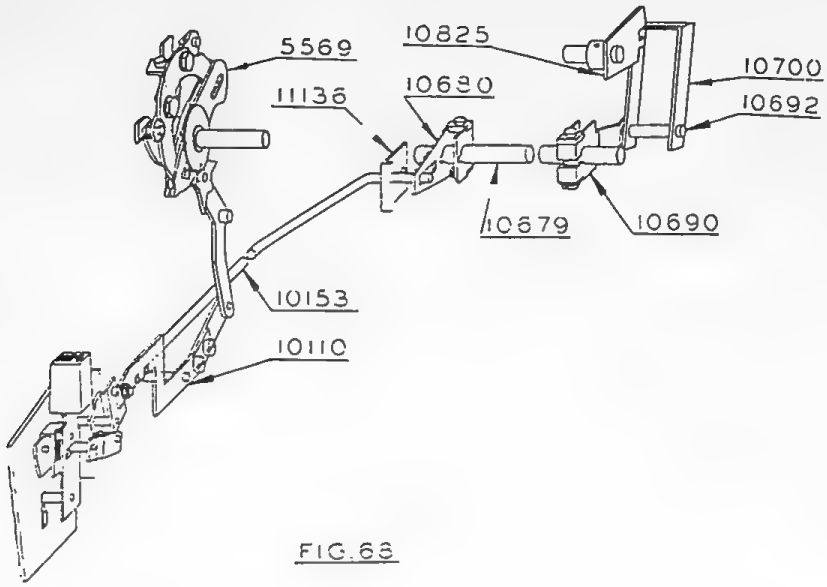


FIG.68

M. NEGATIVE MULTIPLICATION

#130a. Fig. 68. Depression of the NEG-Key causes a reversal of the actuation of the Calculating Carriage.

#130b. The Crank 10110 connects the NEG-Key with the Counting Fingers 5569. (See also "The Counting Fingers" #149 to #156).

#130c. The Reversing Bar 10153 is attached to the Crank 10110 and guided in the Slot Bracket 11136. The Slot Bracket 11136 guides the far end of the Reversing Bar 10153 so that it rocks the Clamp Arm 10680 counter clockwise upon depression of the NEG Key. As the Clamp Arm 10680 rocks, it raises the Shift Scanner 10700 which is pivoted on the Stud 10692 on Clamp Arm 10690. Thus, the relationship between the Shift Scanner 10700 and the Shift Rocker 10825 has been changed to reverse the shift control for the Calculating Carriage.

#130d. For a non-short cut value in the Step Disc 10775 (#107), the Shift Scanner 10700 is lifted by depression of the NEG-Key so that it senses a negative value, when in fact the Shift Rocker 10825 still represents a value to cause a shift to a positive position. A comparison between positive and negative multipli-

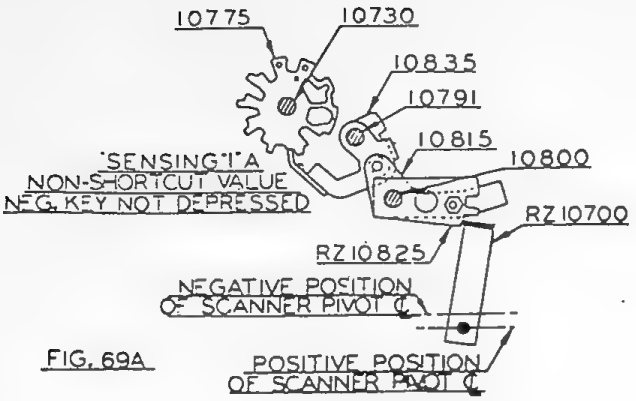


FIG. 69A

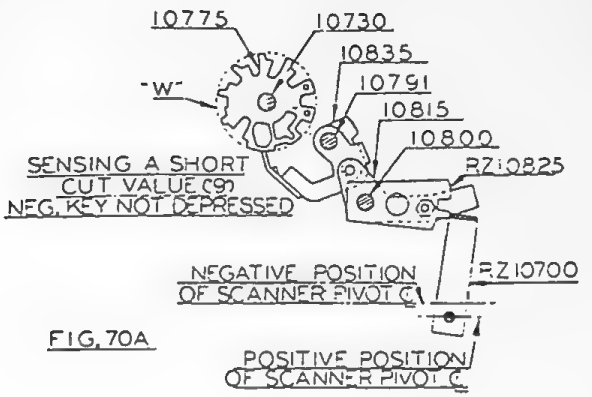


FIG. 70A

cation is shown in Fig. 69A and Fig. 69B. It must be understood that the relationship of the Plus-Minus Sensing Finger 10835 and the Step Disc 10775 is the same and that the only difference is the position of the Shift Scanner 10700. Fig. 70A and Fig. 70B show the same comparison for the sensing of a short-cut value. In positive multiplication, the Shift Scanner contacts the lower tooth of the Shift Rocker 10825. In negative multiplication it passes into the upper notch. Thus, although a short-cut value has been sensed, which in positive multiplication produces the shifting effect described in #109, the Calculating Carriage will be shifted into the positive position according to #108b, or, (if already in a positive position), not shifted at all according to #108a. #131a. The difference between posi-

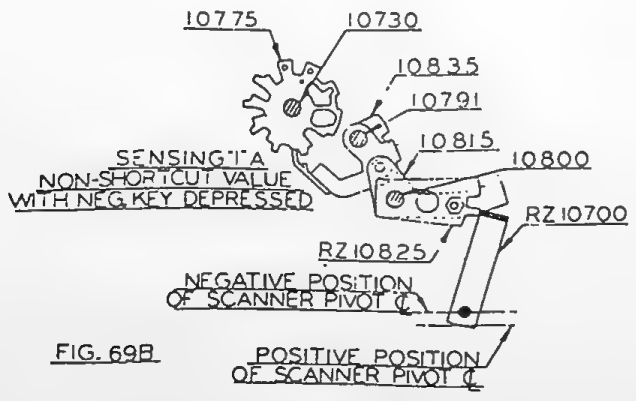


FIG. 69B

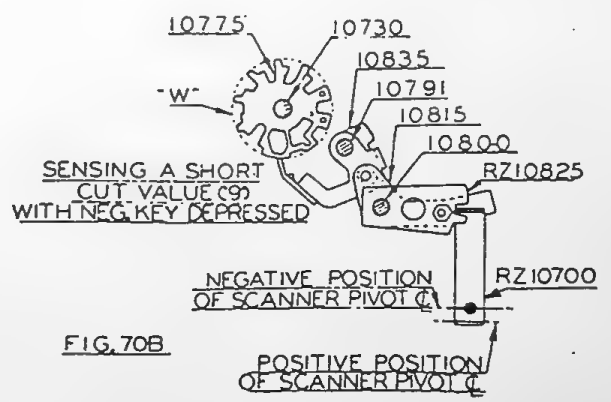


FIG. 70B

tive and negative multiplication may be shown by example as follows: If "6" is to be multiplied by "4", the procedure in positive multiplication is this: The machine senses "short-cut" shifts into the negative half-step position (#109), and adds "4" four times negatively. The Register III shows "....99984". The machine shifts according to #113, corrects according to #108b and adds "40" positively. The Register III now shows "24". The procedure in negative multiplication is reversed. The machine senses "short-cut", but shifts according to #108a or #108b. The value "16" appears in Register III. (Note that "...99984" is the value obtained by subtracting "16" from an empty register). The reversing of the Shift Scanner 10700 has changed the shift of the Calculating Carriage. It has not changed the fact that whenever the Plus-Minus Sensing Finger 10835 senses a short-cut value, the Correction Latch 10528 engages the Ear Rocker 10830 (#117) and prepares a corrective cycle. During the corrective cycle in normal multiplication (#118), the Shift Scanner passes into the upper notch of the Shift Rocker 10825 and the corrective cycle is positive according to #108b.

#131b. However, the Shift Scanner 10700 in its higher position cannot pass into the upper notch. It strikes the upper tooth and the Calculating Carriage is shifted into the negative position, according to #109.

N. SUMMARY OF MULTIPLICATION

#132. Since the description of the various processes in multiplication is of necessity scattered, Fig's. 71a to 71d are provided. It must be stated that these diagrams refer only to the shifting movements of the Calculating Carriage. Beyond that, the diagrams are self-explanatory.

MULTIPLICATION SHIFT OF THE CALCULATING CARRIAGE

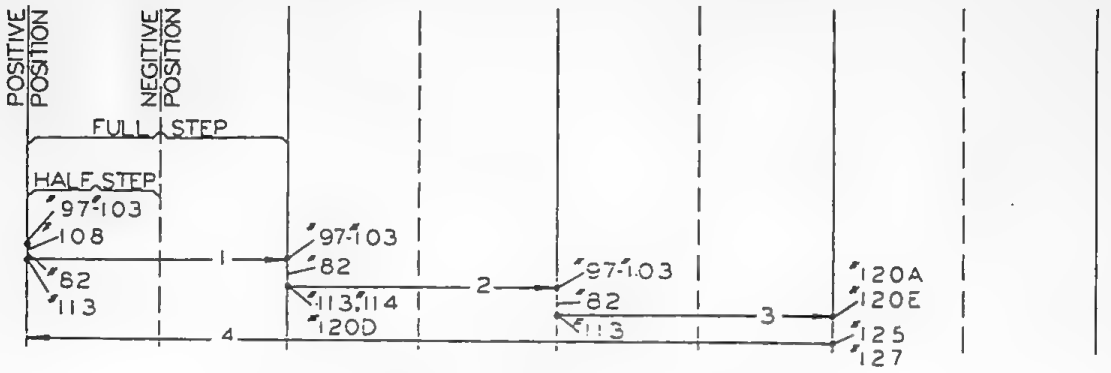


FIG. 71A — THREE DIGIT NORMAL MULT. — POSITIVE

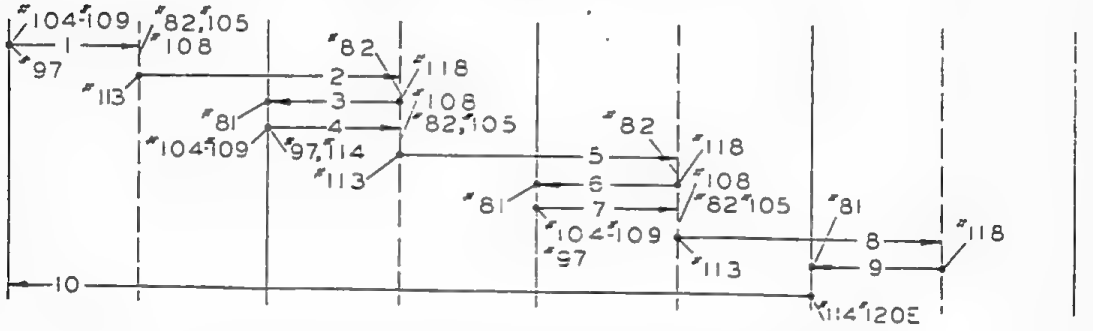


FIG. 71B — THREE DIGIT SHORT-CUT MULT. — POSITIVE

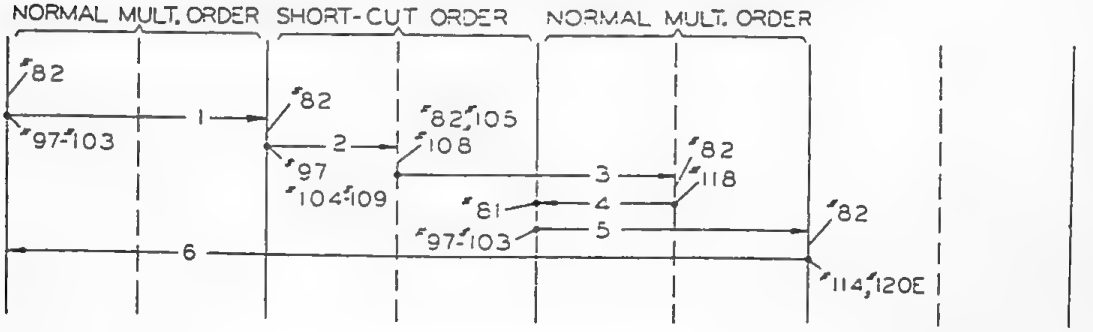


FIG. 71C — MIXED MULTIPLICATION — POSITIVE

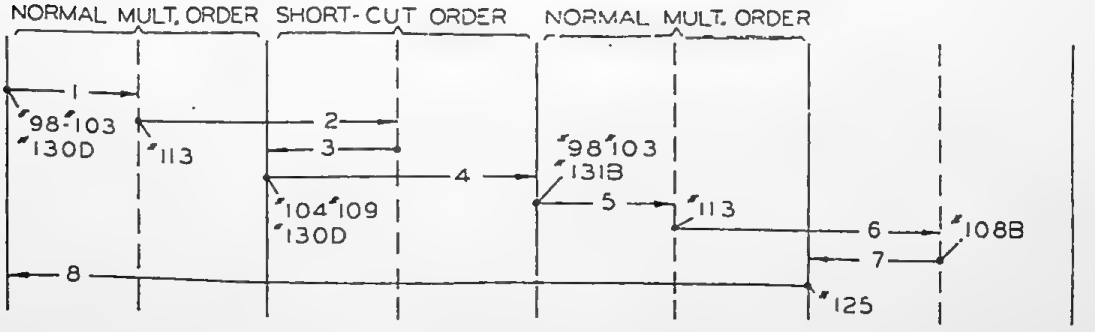


FIG. 71D — MIXED MULTIPLICATION — NEGATIVE

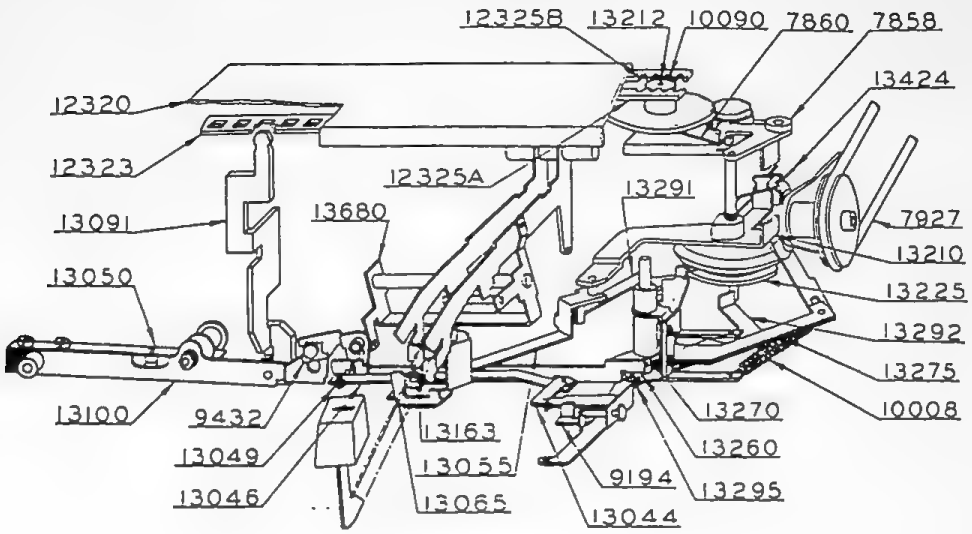


FIG. 72

5. SHIFT OF THE CALCULATING CARRIAGE AND AUTOMATIC DIVISION

A. LOCKING AND SHIFTING IN ADDITION AND SUBTRACTION

#133. Fig. 72. The Calculating Carriage is capable of moving into the positive (addition) and negative (subtraction) positions. Although it appears at times that the Calculating Carriage shifts only one-half step the Calculating Carriage can shift only in full steps. Whenever it seems to have shifted one-half step, it has been moved by action of the Multiplying Mechanism (#108,109), or Add-Subtract Mechanism (#135). Therefore, there are two modes of shifting. By initiating a normal shift (as described hereafter) and by moving the Calculating Carriage for the purpose of obtaining either a positive or a negative one-half step position. If the Calculating Carriage stands in the negative one-half step position, the actuation of the normal shifting will shift it one step, that is into the next higher one-half step position from which it is returned in some cases for the entry of a positive value (#45, #46, #108, #109).

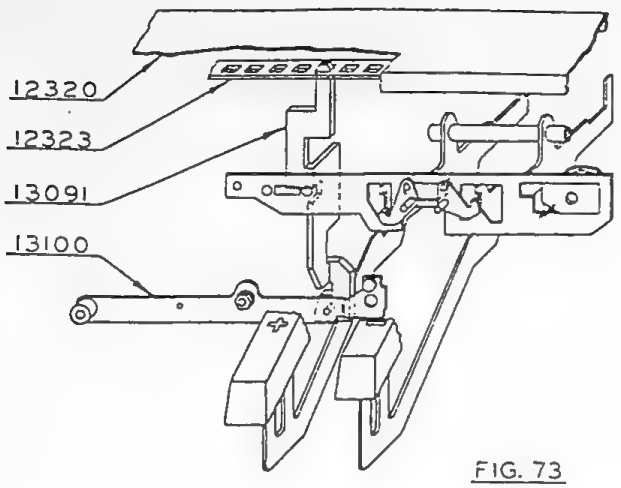


FIG. 73

#134. Fig. 73. The Calculating Carriage is held in its various positions by the Bolt 13091 which engages the square opening in the Step Bar 12323. The Step Bar 12323 is fastened to the Bottom Plate 12320. The Bolt 13091 is pivoted on the Escapement Rocker 13100.

#135. Fig. 74. Aside from the shifting by the Multiplying Mechanism described in #108 and #109 for short cut purposes, the Calculating Carriage must also be shifted into a negative one-half step position for simple subtraction and back into the positive position for simple addition (when such simple addition follows a simple subtraction). This is accomplished by the Plus Key in cooperation with the Plus Toggle 7902A or the Minus Key in cooperation with the Minus Toggle 7902B. The Plus Key engages an ear of the Toggle 7902A, rocks it, and forces the Plus-Minus Slide 13415 to the left. The Minus Key engages an ear of the Toggle 7902B, rocks it and forces the Plus-Minus Slide 13415 to the right. The movement is one-half step. The movement of the Plus-Minus Slide 13415 is transmitted to the Calculating Carri-

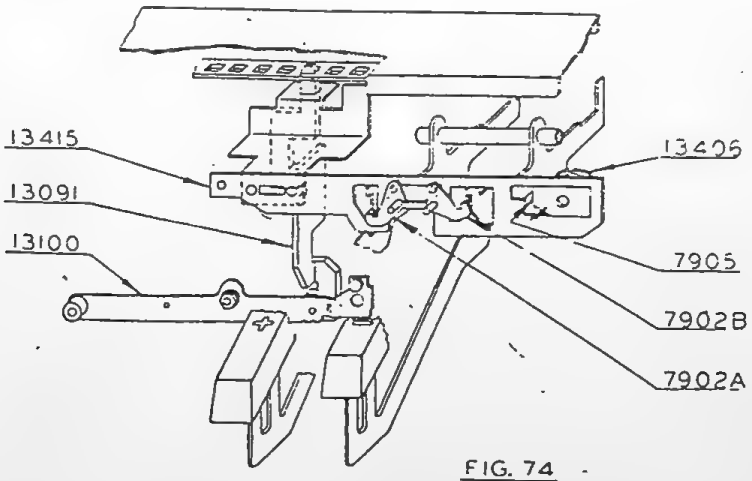


FIG. 74

age through a bracket which is attached to the Plus-Minus Slide 13415 and has a hole through which the Bolt 13091 passes. The Spring 13406 holds the Calculating Carriage in position. A Plate 7905 is provided for adjustment purposes, and limits the movement of the Plus-Minus Slide 13415.

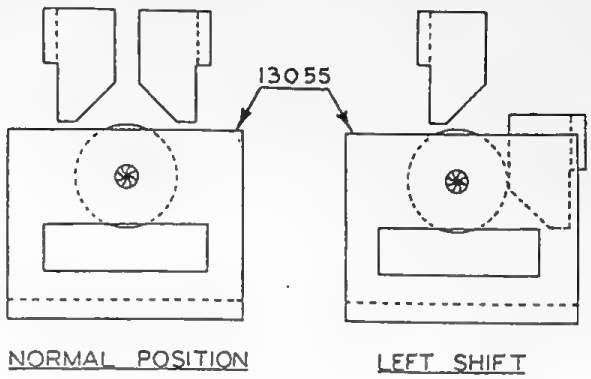


FIG. 75

B. SIMPLE STEP ESCAPEMENT

#136. Fig. 75. A depression of either Shift Key results in a full-step shift of the Calculating Carriage. A cam arm of the Shift Key displaces a Roller Lever 13055 to one side, (right or left), and by fork and pin connection, moves the Swing Bail 13210, Fig. 76, so that the Gear 10090 on Stud 13212 is moved into engagement with one of the two racks 12325A or 12325B, which are attached to the Bottom Plate 12320. The Spring 13424 holds the Swing Bail 13210, the Gear 10090 and the Roller Lever 13055 in a normal position in which the Gear 10090 is centered between the Racks 12325A and 12325B.

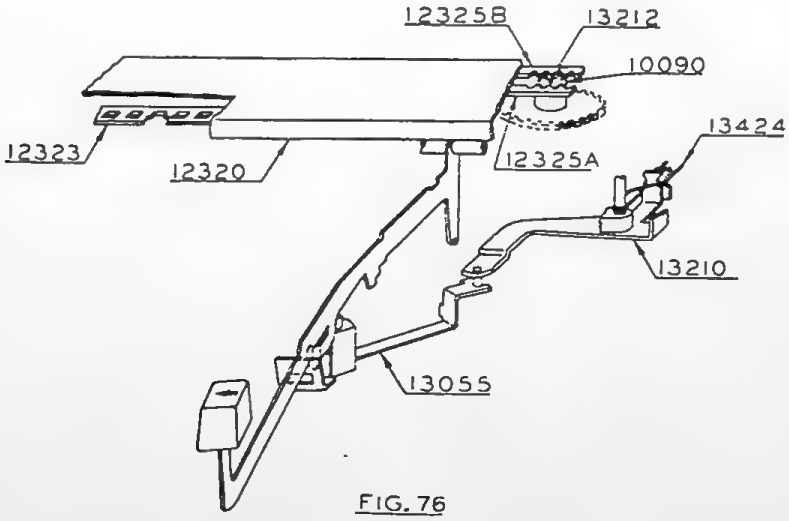


FIG. 76

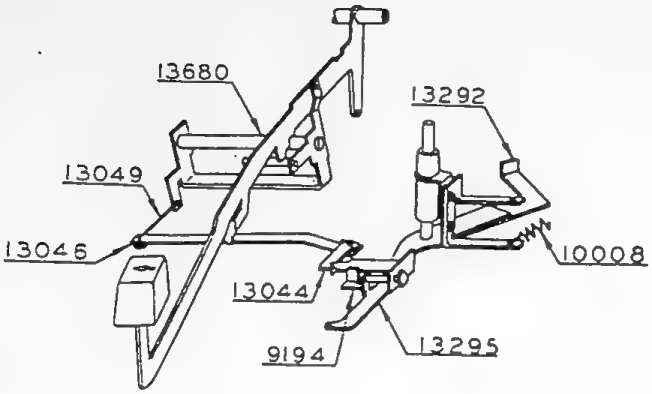


FIG. 77

#137. Fig. 77. The depressed Shift Key also deflects the Transfer Bail 13680. This pulls, (by wire 13049), the Trigger Lever 13046 whose Pawl 13044 pushes the Latch 9194 off a fixed frame member. The Latch 9194 is pivoted on the Arm 13295 of the Setting Lever 13292. The Setting Lever 13292 is now free to follow its Spring 10008 and swing counter clockwise until it is stopped by the Screw, as shown. (Fig. 78).

The movement of the Setting Lever 13292, over Arm "A" results in a disengagement of the Shift Clutch 13225. It goes through one cycle, during which the Stud "B" on the Hub of the Clutch Disc is brought against the lower end of the Setting Lever 13292 to reset it by re-engaging the Latch 9194.

An Arm of the Clutch Pawl 13275 has pulled the Link 13260 which has turned the Lever 13031 far enough to move the Blocking Comb 13070 into the path of all other function keys. (See INTERLOCKS, #157). The Link 13260 has also rocked the Bellcrank 9432.

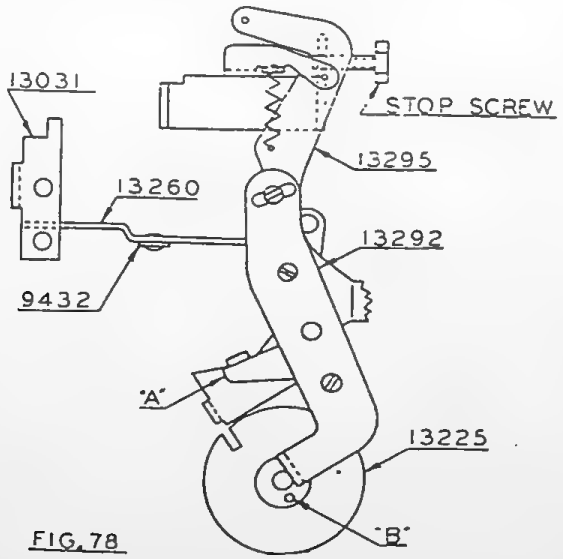


FIG. 78

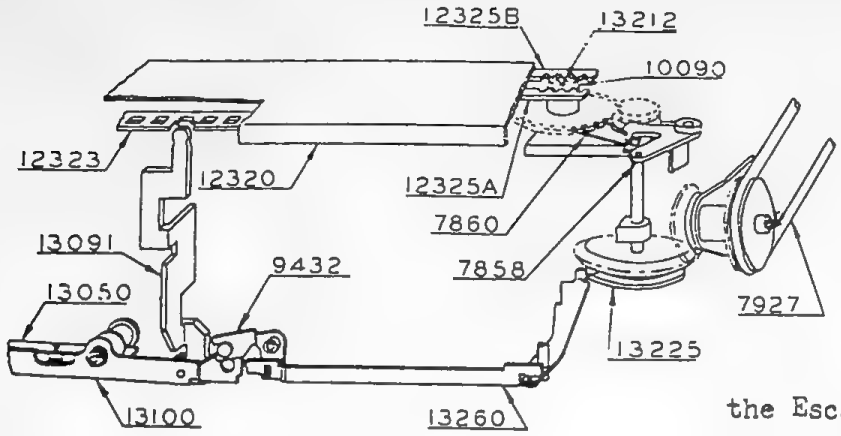


FIG.79

#138. Fig. 79. The Bellcrank 9432, by stud and fork connection, rocks the Escapement Rocker 13100 which closes the Switch 13050 and lowers the Bolt 13091. This removes it from engagement with the Stop Bar 12323. The motor starts and drives the Clutch 13225 by means of Belt 7927 and a Bevel Gear arrangment. The Clutch 13225 drives the Escapement Gear 10090 to shift the Calculating Carriage as previously described.

#139. Fig. 80. In order to prevent the Escapement Gear 10090 from disengaging the Racks 12325, a Blocking Latch RZ7858 is provided. The Lever RZ7860 is adjustably attached to the Swing Bail 13210 and has a Block "C" which normally stands as shown in Fig. 80a. When the Gear 10090 is moved either to the right or to the left depending upon the direction of the shift, and when the Gear 10090 is then driven, the Blocking Latch RZ7858 will be cammed out of the disc and can return only after a full revolution of the Clutch 13225. In this out position, it blocks the return of the Gear 10090 and a reliable engagement with either Rack 12325A or 12325B is assured.

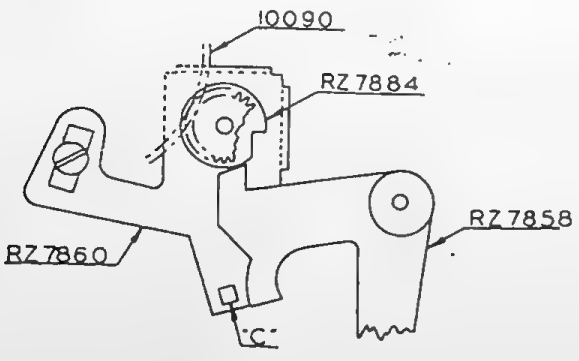


FIG.80

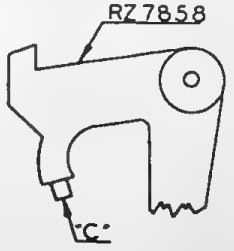


FIG.80A

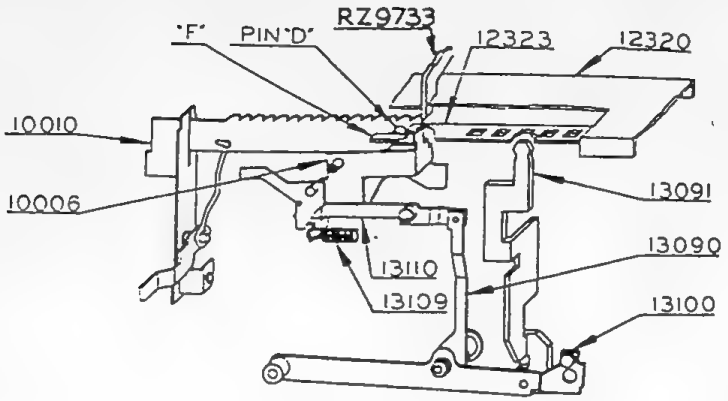


FIG. 81

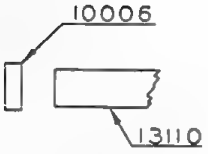


FIG. 81A

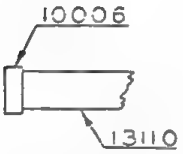


FIG. 81B

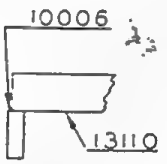


FIG. 81C

C. SHIFT IN DIVISION

#110. Fig. 81. Depression of the "DIV", (Division Preselection), Key lifts the Division Rack 10010 and brings it into the range of the Division Stop RZ9733 which extends through the Bottom Plate 12320. The lifting of Stud "D" on the Division Rack 10010 allows the Stop Lever 10006 to follow, moving its lower end from the position as shown in Fig. 81A, because of the Spring 13109. The Stop Lever 10006 is held under spring tension in front of the Latch 13110 as shown in Figure 81B. Upon depression of the right shift key, the Escapement Rocker 13100 is pulled down, and the left end of Latch 13110 is forced up by Link 13090. It is then held, as shown in Fig. 81C, preventing the Escapement Rocker 13100 from coming up after one cycle. This position is held until the carriage has reached one order from the extreme right position and the cam tail "F" on 12323 depresses the Stop Lever 10006, releasing the Escapement Rocker 13100 to stop the shifting. The Bolt 13091 having been held outside the holes in the Stop Bar 12323, now is lifted into engagement to hold the Carriage one order from the right.

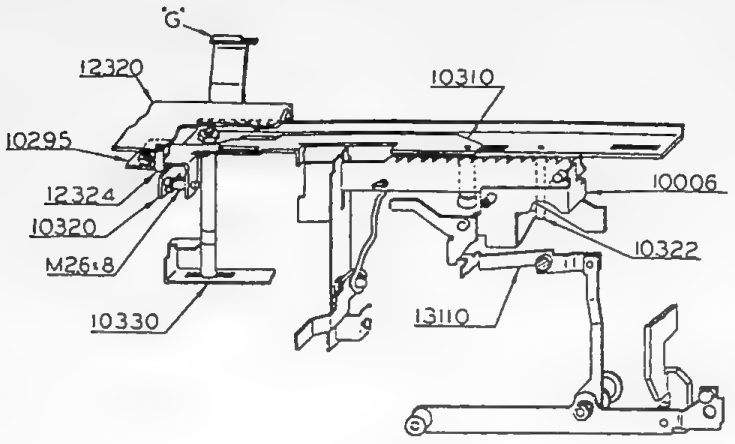


FIG. 82

#141. Fig. 82. At the end of division, the carriage shift is terminated in the following way: The Stop Stud 12324, (on the Bottom Plate 12320), moves the Stop Plate 10295 and the Stop Slide 10310 when the Carriage reaches the lift end position. An Adjustment Screw M 2.6 x 8 on the Stop Slide 10310 contacts an ear of the Slide 10320 and moves it to the left.

#141b. A Stud 10322 on the Slide 10320 contacts the Stop Lever 10006 and rocks it releasing the Latch 13110 as described before.

#142. Fig. 83. The left movement of the Calculating Carriage may be also interrupted by the Division cut-off mechanism which is located on the left side of the machine. When the Cut-off Lever 12418, which is attached to the Calculating Carriage moves against the teeth of the Cut-off Slide 10325, the right bracket "H" of the Cut-off Slide 10325 moves against the Arm "G" (Fig. 82) of the Slide 10320 and moves it, producing the action described in #141b. The Shift is stopped again and also the division.

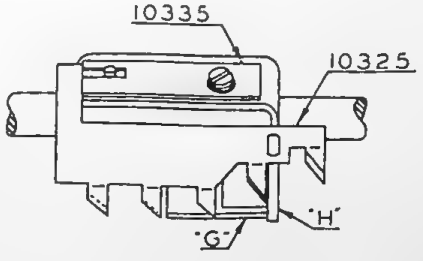


FIG. 83

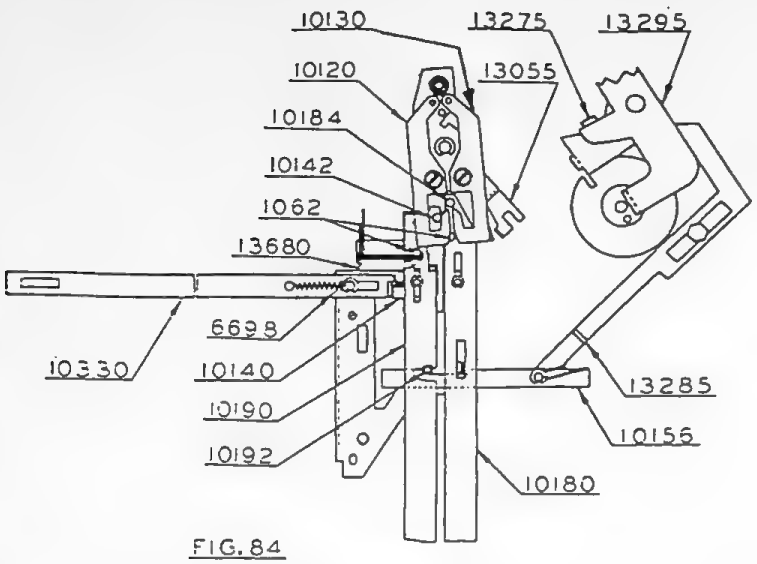


FIG. 84

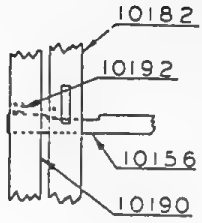


FIG. 84A

D. SHIFT IN MULTIPLICATION

#143a. Fig. 84. The shift to the right is the same in multiplication as in single step shifting, except that it is initiated not by the right shift key, but by the Pull Bar 10180 which is actuated by the Multiplier Mechanism (#113). The return shift is initiated by the Pull Bar 10190 which is also actuated by the Multiplier Mechanism (#127). In both cases, the Roller Lever 13055 is moved in the proper direction by the Stud 10142 on the Pull Bar 10190 (left shift) or Stud 10184 on the Pull Bar 10180 (right shift) which engage the Cam Levers 10120 and 10130, respectively. The shift itself has been described in the preceding paragraphs.

#143b. In the shift to the right, the Stud 1062 on Pull Bar 10180 actuates the Transfer Bail 13680 which then functions as described in #137. In multiplication, there are only single step shifts to the right, and the Pull Bar 10180 is actuated according to #113 for every shift.

#143c. The return shift in multiplication is a continuous shift until the end position is reached. It is initiated according to #110 when "NO VALUE" is sensed. In order to prevent interruption of the shift after one cycle of the Clutch 13225,

(which has been started by the 1062 on the Pull Bar 10190), the Holding Slide 10330 is provided. When the Pull Bar 10190 is moved, the ear on the Holding Slide 10330 latches it and holds it in the shift position. When the Calculating Carriage has reached the end position, the Slide 10320 is actuated normally according to #144b, or in conjunction with the Cut-off Slide 10325 (#142). The Latch 10156 provides a means to keep the Clutch Pawl 13275 disengaged while the Calculating Carriage returns to the left end position. When the Pull Bar 10190 is in normal position, a square block fastened to it is positioned clear of the notch in Latch 10156, Fig. 84A. When the Pull Bar 10190 is actuated, the square block is moved against the Latch 10156, deflecting it slightly. During the first cycle of the Clutch, the Latch 10156 is moved to the left, the notch engages the square block which holds the Latch 10156 until the Pull Bar 10190 is released as described above.

E. AUTOMATIC DIVISION

#144. Fig. 85. In division, it is necessary to align the two factors thus:

XX (Divisor in Register I)
XXX (Dividend in Register III)

The overlapping is necessary in order to provide for a proper start of the division. Before entry of the first factor, i.e. the dividend, the Calculating Carriage must be shifted as described in #140. The Division Rack 10010, which has been rocked up by depression of the Division Pre-selection Key, is positioned one full shift step away from the Division Stop RZ9733. The Dividend, therefore, will be entered into the leftmost order of the Calculating Carriage by depression of the Plus Key. The Divisor is then entered by depression of the I/X Key. It will appear in the leftmost order of the Register I. (#42).

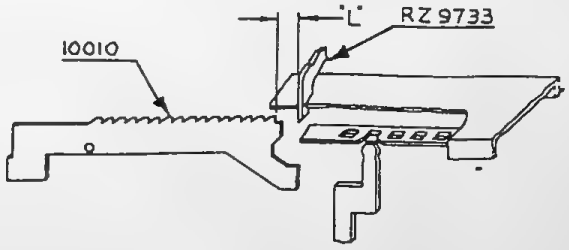


FIG. 85

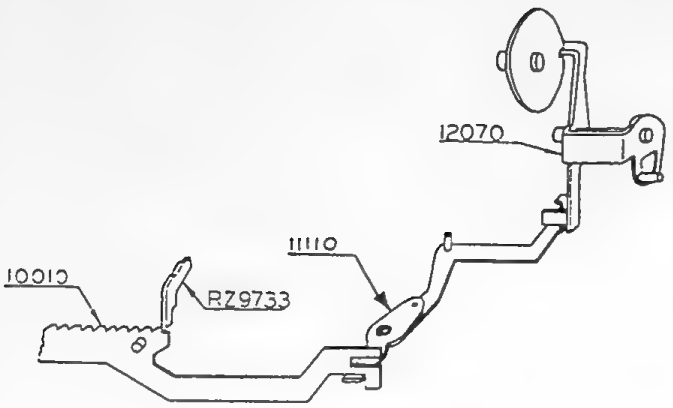


FIG. 85A

#145. Fig. 85A. The Left Shift Key is then depressed and the Calculating Carriage is driven one division position (on half step) to the left by the Belt 7927. (Fig. 72). When the Calculating Carriage has moved the distance "L", (Fig. 85), the Division Stop RZ9733 contacts the Division Rack 10010 and stops the Calculating Carriage in a subtractive position. The motor, however, continues to run, driving the Belt 7927 which slips on the pulley and acts as a spring of constant tension.

#146. The Division Stop RZ9733 has deflected the Division Rack 10010 to the left enough to actuate the Link 11110 which opens the Main System Clutch by deflecting the Main System Pawl 12070 (#47). The Main System begins to cycle and the Divisor, which is now lined up with the Dividend in this fashion,

XX Divisor
XXX Dividend

is subtracted from the Dividend until an overdraft occurs. The overdraft causes a tens-carry which deflects the Division Stop RZ9733, withdrawing it from engagement with the Division Rack 10010. The Division Rack 10010, spring urged, moves to the right far enough for its next tooth to block on the Division Stop RZ9733 when it moves down. The Calculating Carriage has been held during this process by a locking tooth which is described under "INTERLOCKS, (#157). When the Calculating Carriage is released from this locking tooth, it shifts to the left until the Division Rack 10010 is moved leftward far enough to close the Main System Clutch.

#147. The teeth on the Division Rack 10010 are spaced so that the first tooth holds the Calculating Carriage in a negative position, the second in a positive position, the third again in a negative position. Thus, the SUBTRACTION PLUS OVERDRAFT in the first position is followed by an addition in the next position of the rack. Only one positive cycle is possible because, being a REVERSED OVERDRAFT and tens-carry, it retracts the Division Stop RZ9733 once more. The Calculating Carriage shifts as before, stopping in a negative position. The next order of the quotient is established by one or more subtractions, followed by an overdraft with a restoration in the positive position and a further shift to the next negative position.

#148. Fig. 86. The division continues in this fashion until the dividend is reduced to zero or until the Calculating Carriage reaches the left end position. If the division is even, for example, the dividend "12" and the divisor "4", the later part of the shift will be a series of overdrafts and restorations to the value "0". If the division is uneven, as when the dividend is "11" and the divisor "4", the division will continue through the shift range until the Carriage gets into the LAST POSITION which is POSITIVE. This last position is distinguished on the Division Rack 10010 by the absence of a following tooth. Thus, the next shift does not start the Main System and no further subtraction is possible. The motor, however, is still running with the Belt 7927 driving the shift a short distance farther than for an ordinary half-step shift. During that last shift, the machine is stopped as described in #141 or #142.

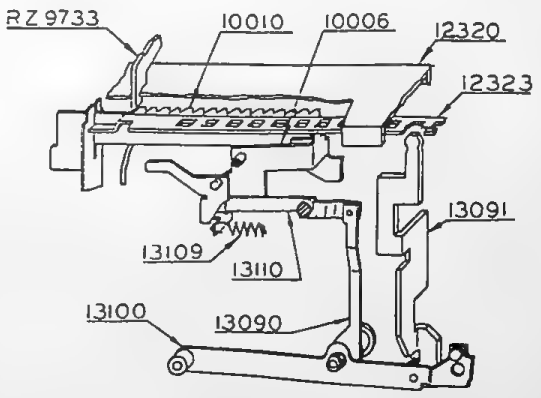


FIG. 86

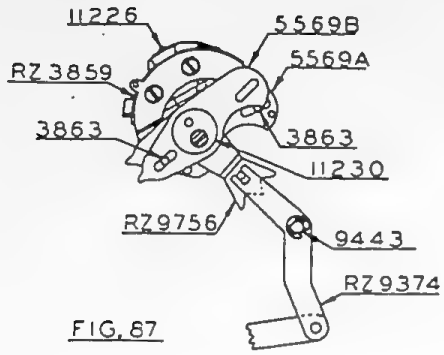


FIG. 87

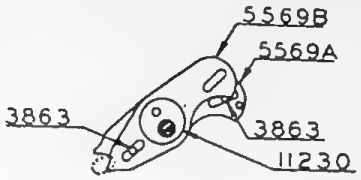


FIG. 87A

6. THE COUNTING FINGERS

A. MODE OF OPERATION

#149a. Fig. 87. The Counting Fingers 5569A and 5569B are located on the left side of the machine, on the Main System Shaft 11400, and driven by the Eccentric 11230. They move in opposite strokes, one clockwise, the other counter clockwise. The difference in movement is caused by the four Studs 3863 on Plate RZ3859. Two Studs 3863 may engage the rear slot of the Counting Fingers 5569A and 5569B and the other two Studs 3863 the forward slot of the Counting Fingers 5569A and 5569B. When the Eccentric 11230 on which both Counting Fingers are mounted, turns, the Counting Fingers oscillate because they cannot follow the circular movement of their centers but are restrained by the fixed Studs 3863 on RZ3859. They move forward and backwards, while their tips describe elliptical movements, as shown on Fig. 87A.

#149b. The direction of movement of the Counting Fingers can be reversed by rocking the Plate RZ3859 so that the Counting Fingers 5569A and 5569B may be engaged in either the rear slot or forward slot by Studs 3863.

#150. The direction of the Counting Fingers is controlled by the NEG-Key (#130). When the NEG-Key is depressed, the Lever RZ9374 on Shaft 9443 is rocked, forcing it against the cam edges on the Plate RZ3859 which is located between the Counting Fingers and carries the Studs 3863. If one of the Counting Fingers 5569 are engaged by Stud 3863 in the forward slot,

then the other Counting Finger 5569 must be engaged by Stud 3863 in the rearward slot. When driving with the NEG-Key up, the forward slot in the Counter Finger 5569B and the rear slot of 5569A will be engaged by Studs 3863. When driving with the NEG-Key depressed the forward slot in the Counter Finger 5569A and the rear slot of 5569B will be engaged by Studs 3863.

#151. The purpose of the Counting Fingers 5569A and 5569B is to count the revolution of the Main System Shaft 11400. They oscillate once for every revolution and one of them will turn one of the Intermediate Gears RZ4725. Since the Intermediate Gear RZ4725 meshes with the Dial RZ4729 of Register II, every revolution of the Main System Shaft is registered in Register II. There must be two Counting Fingers because the machine does not subtract by reversing the Main System Shaft, but by shifting the Calculating Carriage to the negative half-step position with the Counting Finger 5569B taking over. Since Counting Finger 5569B oscillates in the opposite direction of Counting Finger 5569A, the dial of Register II will be driven in the opposite direction. The direction of Counting in Register II is therefore consistent with the direction of calculating in Register III. In both Registers, a half-step shift reverses the direction of count and calculation while the Main System Shaft 11400 continues to cycle in the same direction.

B. TENS-CARRY IN REGISTER II

#152. Although it is not to be expected that the Main System will go through more than nine cycles in any calculating order in multiplication or division (because of the ordinal shift), it is possible that the operator might continue addition or subtraction more than nine cycles, by holding the Add Key or the Subtract Key depressed. In this case a tens-carry will be necessary in the Register II.

#153. The tens-carry in Register II is accomplished by the Carry Levers RZ5368, which engage the Intermediate Gears RZ4725, and by the transfer tooth on the Dial RZ4729. When a Dial RZ4729 turns from "9" to "0" or, from "0" to "9", the transfer tooth engages the small gear of the Intermediate Gear RZ4725 to its left, and drives it one unit. The Intermediate Gear RZ4725 in turn drives the Dial RZ4729 one unit.

#154. Theoretically, this would be sufficient to produce a one-order carry and even a chain carry (transfer wave). However, there must be some clearance between the various engaging gears, and the one unit drive on the first Intermediate Gear RZ4725 would not be sufficient to produce a chain carry. The drive would be lost after about two orders. In order to overcome this difficulty, Transfer Levers RZ5368 are provided in all orders. They engage the Intermediate Gears RZ4725 under spring pressure, and are retracted during tens-carry, and other movements of the Intermediate Gears RZ4725. Cam Levers RZ1337, each have a cam arm and transfer arm. The cam arm is lined up with, and forces the Transfer Lever RZ5368 into the Intermediate Gear RZ4725. The transfer arm contacts a stud in the cam arm of the next left Cam Lever RZ1337 and actuates it. This transfer is accomplished after the first Cam Lever RZ1337 has rocked a short distance. Thus, the Cam Levers RZ1337 force the Transfer Levers RZ5368 into the Intermediate Gears RZ4725 with a delay between orders in the tens-carry. The Cam Levers RZ1337 are actuated, once per cycle of the Main System, by the Roller Bail 11260 which is controlled by a cam on the Main Shaft 11400.

#155. Fig. 87B. Tens-carry is accomplished as follows: When the rightmost driven dial turns from "9" to "0" or "0" to "9", its carry tooth engages the next left Intermediate Gear RZ4725 and turns it one tooth. The Intermediate Gear RZ4725 turns the next left order dial, but not quite one unit because there is some loss, due to play between the

gears. If the second dial should also require a tens-carry, the procedure would be repeated and the total loss increased. In a carry over of several orders, the motion of the initial carry would be consumed in about three orders. However, the Transfer Lever RZ5368 in the next order to the left of the driven order will be forced into the Intermediate Gear, and drive its dial fully home. As the carry wave tends to flatten out to the left, each dial will in turn be driven home by its Transfer Lever RZ5368 camming the Intermediate Gear RZ4725. This is done by the Roller Bail 11260 camming the Cam Lever RZ1337 against the Transfer Lever which will then drive the dial to the home position. Each Cam Lever RZ1337 will in turn cam the next Lever to its left, which will drive its dial to the home position despite the loss from one Cam Lever RZ1337 to the other. There are no Cam Levers RZ1337 in the last two orders, but weights on the Transfer Levers RZ5368 carry them (after the initiated impulse) far enough to complete the carry wave.

#156. Register II is essentially a revolution counter. Its function in the various operations is as follows: Addition: With the Calculating Carriage in the left end position, the rightmost dial is driven in the plus direction one digit for every revolution of the Main System by the Counting Finger 5569A. Tens-carry is accomplished as previously described. Subtraction: In subtraction the Calculating Carriage is shifted to the negative position and the Counting Finger 5569B is brought into driving position with respect to the rightmost dial. Since the oscillation of the Counting Fingers are reciprocal, the unchanged direction of actuation of the Main System drives the rightmost dial in the opposite direction. If it is reduced to a value less than "0", a tens-carry occurs and the Register II exhibits the complementary value of the count. Multiplication: The count starts at the rightmost order. When a non-short cut multiplier order is sensed,

the number of revolutions is positively counted. When a short cut value is sensed, the number of revolutions is negatively counter, i.e., by subtraction of the complement is also the method used in short-cutting. For example, if the multiplier is six, the machine will make four revolutions because ten minus four equals six. If now the machine subtracts in Register II "4" from the empty dial, "6" will result, which is the correct positive value of the multiplier, even though it has been produced negatively. Division: In division, the first figure of the quotient is produced in the leftmost order of Register II. The depression of the Division Pre-selection Key has, however, reversed the Counting Fingers. The negative revolutions are now counted positively. Overdrafts are also counted but corrected during the correction cycles which count negatively. It is possible to depress the NEG-Key while the Division Pre-selection Key is depressed. In this case, the count will be reversed, as when the quotient already in the Register II is to be reduced by a subsequent quotient. If the NEG Key is down, depression of the Division Pre-selection Key will release it.

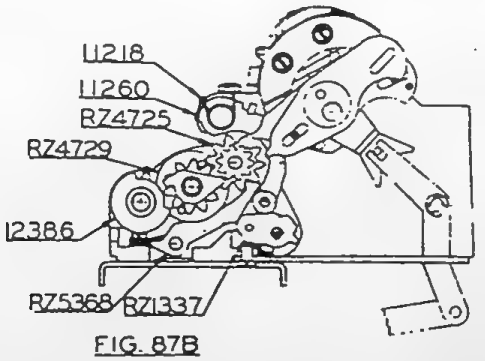


FIG. 87B

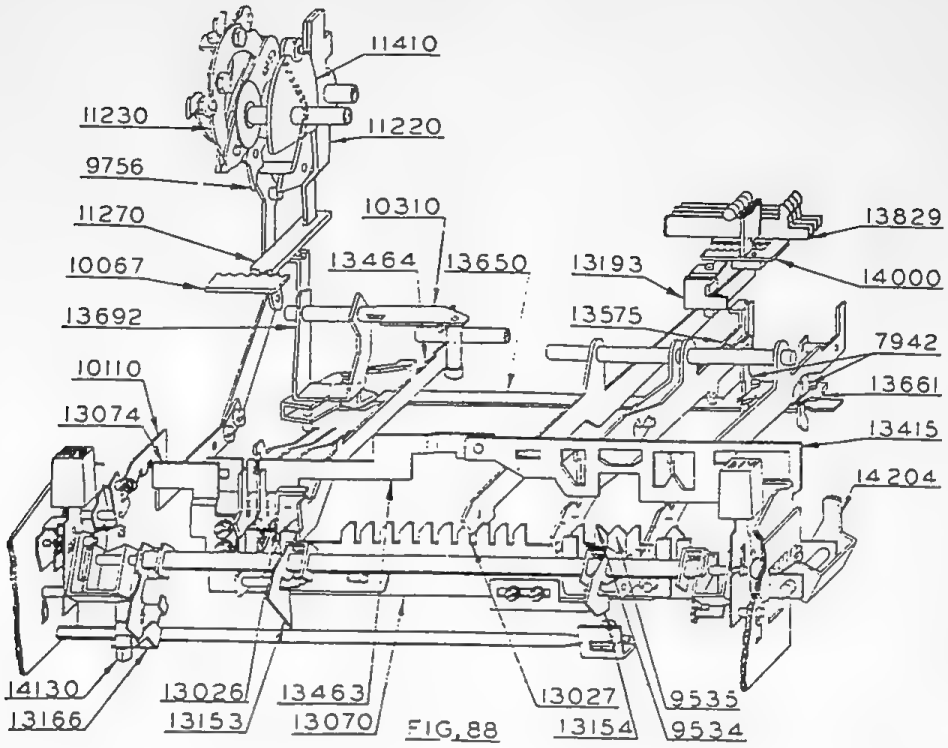


FIG. 88

7. INTERLOCKS.

A. INTERLOCKS FOR THE VALUE AND FUNCTION KEYS.

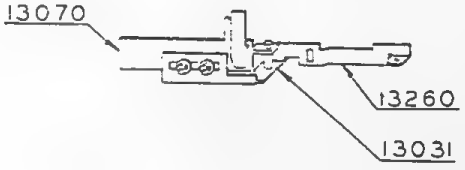


FIG. 88A

#157. Fig. 88. Simultaneous depression of any two value keys is prevented by steel balls, so arranged that there is only room for one Intermediate Lever 13829 to go between them.

The Blocking Segment 9534, 9535, 13026, and 13027, which underlie the value and function keys, make it impossible to actuate any two keys at the same time or a second function before the first one is completed. A depression of a value key moves the underlying Blocking Slide 13027 (long) to the right. This blocks all function keys to the right of the value keyboard. The Blocking Segments 9535 and 9534 are to the right of the Blocking Segment 13027 and block the function keys to the right of the value keyboard against one another. The Blocking Segment 13027 also actuates the Segment 13026 which blocks the II/III Key and the I/X Key with respect to the Equals Key.

When the Calculating Carriage moves, (Bar 13091 disengaged from Escapement Bar 12323, #138), the Blocking Slide 13070 is moved laterally by actuation of the Release Setting Lever 13295 (Fig. 72) through Pull Bar 13260 and the Lever 13031. (Fig. 88A). This blocks all function keys except the Shift Keys. Movement of the Blocking Slide 13070 (Plus, Minus and Equals Key) also moves the Blocking Segment 13074 which blocks the Negative and Division Keys through a slot in the Bar 10110.

During escapement of the Calculating Carriage to the left, the long arm of the Blocking Angle 13166 positions itself before the arm of the Blind Holder 14130 and prevents the Pre-selection Keys from being depressed.

B. BLOCKING WHEN THE DIVISION PRE-SELECTION KEY IS DEPRESSED.

#158. Fig. 88. Depression of the Division Pre-selection Key moves the Plus-Minus Slide 13415 to the left through Bail 14204. This brings the Calculating Carriage into the proper starting position, (Plus position, #135). At the same time the Bails 13154 and 13153 are rocked into engagement with a stud on the Minus Key and Equals Key, respectively, to block depression of these keys.

C. BLOCKING WHEN THE ENTRY CAPACITY OF THE PIN CARRIAGE IS EXHAUSTED.

#159. Fig. 88. When the Pin Carriage 14000 is in the 9th position, the movement of the fixed Latch 9018 (Fig. 17) is blocked by the outer rack in the bottom plate of the Pin Carriage. This prevents a further actuation of the value keys (Fig. 21). The escapement of the Pin Carriage from the 8th to the 9th position also rocks the Blocking Bail 13193, moving an ear over the Lever 13575. This Lever is coupled with the Plus Key when the Division Pre-selection Key is depressed and results in the Plus Key being blocked when the dividend capacity is exceeded.

D. BLOCKING WHEN THE PLUS OR MINUS KEY IS DEPRESSED.

#160. Fig. 88. In addition to the

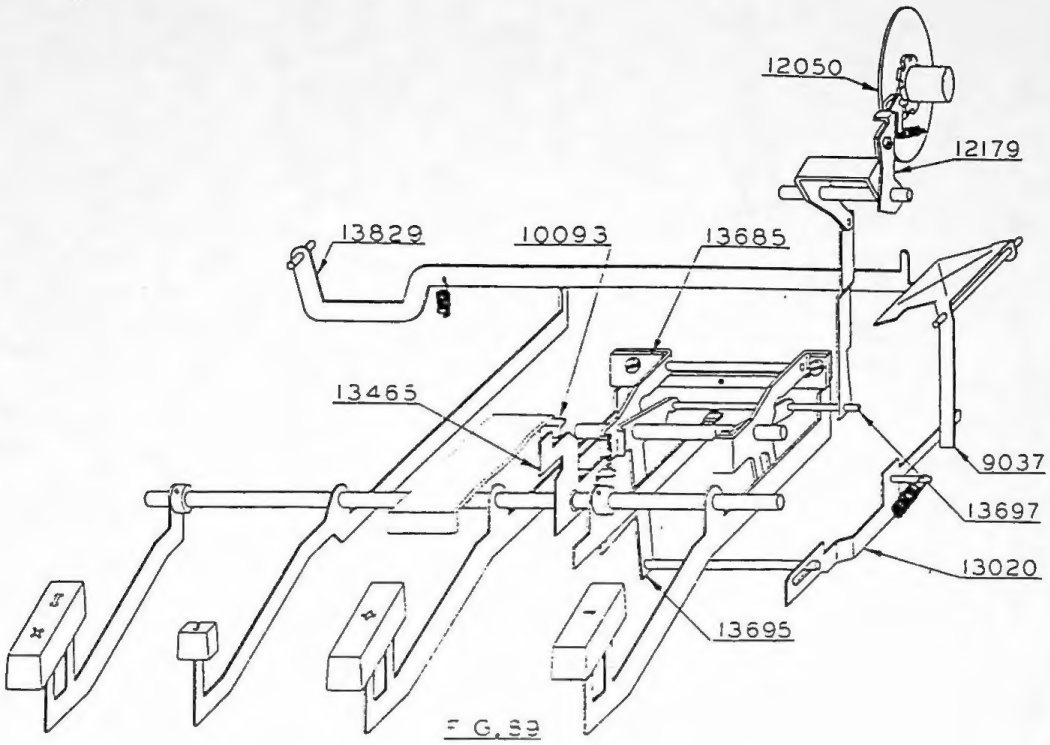


FIG. 89

interlocks described under A, above, the following provisions are made: The Live Latches 7942 on the Plus Key and Minus Key, move under set screws in the Stop 13661 when the Plus or Minus Key is depressed. The keys are then held in the depressed position until, during the cycle of the main system, the Transport Lever 11220, through the Slide 11270, and the Bail 13692, moves the Release Bar 13650. If the machine is not connected to the electric power, this interlock prevents depression of any other key.

When the Calculating Carriage is in the 10th position, the Plus or Minus Key is blocked by the Stop 10093, by way of the Rocker 13685 and the Blocking Lever 13465. (Fig. 89).

E. BLOCKING DURING A MAIN SYSTEM CYCLE.

#161. Fig. 88. The Slide 11270, moved by the Cam 11410 through the Transport Lever 11220, engages the Interlock Rack 10067 in the Calculating Carriage during every main system cycle. The Calculating Carriage is thereby held in its respective position during a calculation.

During a main system cycle, the Stud which extends from the Transport Lever 11220 (which is controlled by the Cam 11410) is rocked into the notches of the Shift Lever 9756. This prevents a reversing of the Counting Finger Plate 11230 during a calculation.

F. BLOCKING DURING A CYCLE OF THE ENTRY CLUTCH.

#162. Fig. 89. During a cycle of the Entry Clutch, the Clutch Lever 12179 is disengaged from the Entry Clutch 12050. The Blocking Slide 13020, controlled by the movement of the Entry Rocker 13695 is allowed to move rearward where it will block the movement of the Rocker 9037, plus preventing a value key from being depressed.

G. BLOCKING AFTER ACTUATION OF THE MAIN SYSTEM PAWL.

#163. Fig. 90. During a main system cycle, the disengaging of the Main System Pawl 12070 moves the Stud 12071 in front of the Blocking Ear of the Carriage Clear Pawl 12110 which prevents the Carriage Clear Clutch 12060 from becoming activated.

H. BLOCKING DURING "BACKTRANSFER".

#164. Fig. 90. If values are contained in the Entry Mechanism RZ11600, the Clear Bail 11655 and the Blocking Segment 12125 which is connected with it are out of their normal position. An ear on the Blocking Pendalum 10001 underlies the Blocking Segment 12125 which prevents depression of the Back Transfer Key. During the backtransfer operation, engagement of the Intermediate Gears 4566 with the System Gear 11426 and the Entry Segment 11415 is maintained by the arm of the Blocking Bail 12150 rocking under the Blocking Stud 11778. This, by way of the Push Bar 10002, also holds the Back Transfer Key in the depressed position (Fig. 36).

J. BLOCKING DURING THE CLEARING OF THE CALCULATING CARRIAGE.

#165. Fig. 88. Upon depression of the II/III Key, when the Calculating Carriage is out of position, the Plus-Minus Slide 13415 is moved into position by means of the Slide 13463.

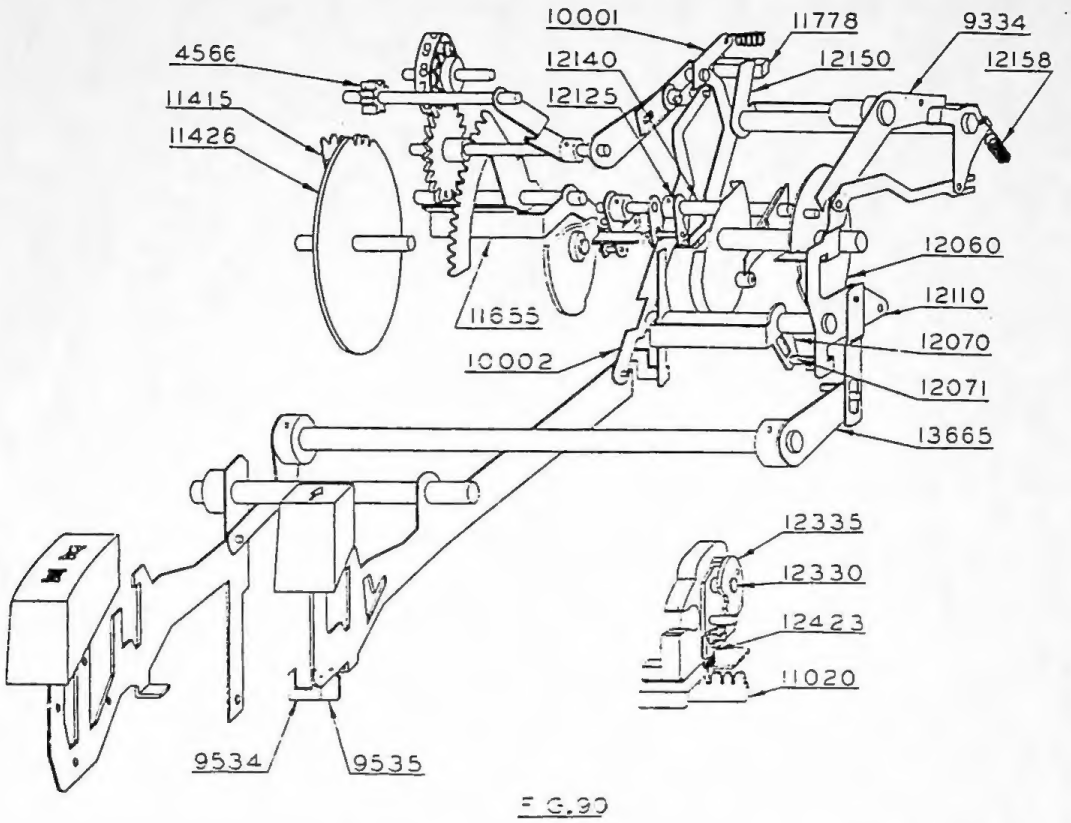


FIG.90

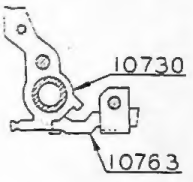


FIG.91

Should it happen that the Calculating Carriage is exactly between the Plus or Minus position, the nose of the Slide 13463 will block the II/III Key. The II/III Key is held in the depressed position by the Key Latch 12100 and the square on the Lever 13665 (Fig. 33). All function keys, except the I/X Key will then be blocked. The cycling of the Clear Clutch 12060 unlatches the keys by rocking the Key Latch 12100 through the Turn Lever 9334 and the Push Bar 9865. If one Clear Key is depressed, the other is Blocked by means of Link 13180 (II Key), Link 13191 (III Key), and the ear of the Lever 13125. (Figs. 34 & 35). The Dial Shaft 12330, (Fig. 90), which revolves during the clearing operation, depresses the Slide 12423 by way of the Cam 12335. The Slide 12423 enters into the Blocking Bar 11020 and locks the Carriage during the clearing operation.

K. BLOCKING THE I/X KEY WHEN A VALUE KEY IS DEPRESSED.

#166. Fig. 89. When a value key is depressed, the arm of the Rocker 9037 moves into a position to block the Blocking Slide 13020. This blocks the I/X Key and prevents the Entry Latch 12179 from disengaging.

L. BLOCKING THE EQUALS KEY.

#167. Fig. 88. The remarks "K", above, apply also to the Equals Key. When the Calculating Carriage is out of its home position, the Slide 13464 is under the ear of the Equals Key preventing its depression. When the Equals Key is released at the end of the operation, the Slide 13464 moves into its locking position, preventing a redepression of the Equals Key during the Calculating Carriage return shift. The Slide 13464 is retracted from its locking position, when the Calculating Carriage moves into the home position by Stud 12324, (Fig. 82), which extends from the Bottom Plate 12320 and retracts the Slide 13464 by means of the Slide 10312.

M. BLOCKING DURING MULTIPLICATION.

#168. Fig. 88. The Equals Key is held in a depressed position during the multiplication, first by the Lever 13630 and the Fork 13595 (Fig. 39), then when the Clutch Pawl 10540 is disengaged from the Clutch 10645 by the Angle 10503 (Fig. 41). Should it happen that a sharp depression of the Equals Key fails to latch the Equals Key as described above, the Side Plate 10730 of the Multiplier Rocker will place itself over the ear of the Bail 10763, which will hold the Equals Key depressed. Upon completion of multiplication, the Pull Bar 10190 releases the first locking of the Equals Key (Fig. 67) and the Clutch Pawl 10540 the second locking (Fig. 41). This happens only after the return shift of the Calculating Carriage has been initiated. During this time, the Blocking Slide 13070, which has been laterally moved by the Setting Lever 13295, provides locking for the other function keys (Fig. 72).